

BOOK OF ABSTRACTS

ICAS-EMME 3

Third International Congress on Archaeological Sciences in
the Eastern Mediterranean and the Middle East

14-18 March 2022

The Cyprus Institute, Nicosia, Cyprus



CAARI
Cyprus American Archaeological
Research Institute



Πανεπιστήμιο Κύπρου
University of Cyprus



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Edited by

Artemios Oikonomou and Thilo Rehren

The Cyprus Institute, Nicosia, Cyprus

2022

In memory of Professor Vassos Karageorghis

In late 2021, **Professor Vassos Karageorghis** passed away, at the age of 92. From its beginning, Professor Karageorghis has been a strong supporter of STARC and steadfast adviser, both through his role within Cyl and in the A.G. Leventis Foundation. His impact on Cypriot archaeology cannot be overestimated, as long-standing Director of the Department of Antiquities, and as a supreme excavator and scholar of the Archaeology of Cyprus. He has played a leading role in the establishment of key academic institutions, including the foundation of the Archaeological Research Unit at the University of Cyprus, and most recently the Cypriot Academy of Sciences, Letters and Arts. From a very early stage of his



professional life, Professor Vassos Karageorghis has been a staunch supporter of what Archaeological Sciences can do for Archaeology, realizing (in his own words) *‘that without them we cannot make any real progress in our research’*. However, without the acceptance of what the sciences have to offer, demanding that they address archaeological questions, and providing the intellectual and structural climate to enable their full integration into Archaeology, Archaeological Science would be void of purpose. Professor Karageorghis provided all this, and so much more, as part of his life-long work to establish archaeology in all its facets in Cyprus, as a Cypriot endeavour.

He supported the development and growth of STARC through his active personal engagement, and as a member of the Center’s Scientific Expert Panel. He had a leading role in the innovative “Digital Ancient Cypriot Literature” project, which was the first step in creating [DIOPTRA](#): the Edmée Leventis Digital Library of Cypriot Culture, a flagship Cyprus Institute project towards the documentation and preservation of the rich Cultural Heritage of Cyprus.

He also led and contributed to a range of research efforts on Cypriot archaeology and museums, such as the “Cypriot Antiquities in Foreign Museums: The Pittas Registry” project, while generously sharing with younger colleagues his broad network of contacts and collaborators. He published three books through Cyl, detailing his excavations in Palaepaphos and Salamis. And he practiced what he was preaching – he was the lead author on a science-based study of the glass inlays in the Iron Age ivory furniture from the Royal Tomb 79 in Salamis, published in the *Journal of Glass Studies*, and of another one on a Late Bronze Age copper hoard, published in *Historical Metallurgy*. Both were co-authored with Cyprus-based archaeological scientists from STARC and ARU, respectively, institutions he helped to establish.

Professor Karageorghis leaves behind a huge void as well as a massive legacy, and will be missed for his personal warmth as much as for his erudite contributions to our academic discourse, and his unparalleled institutional achievements.

This Book of Abstracts is dedicated to the memory of Professor Vassos Karageorghis.

The Organising Committee

ICAS-EMME 3 conference is co-sponsored by:



Honor Frost Foundation (HFF)



The Society for Archaeological Sciences (SAS)



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Foreword

After a successful ICAS-EMME 2 in November 2019 we are delighted to welcome you to the 3rd International Congress on Archaeological Sciences in the Eastern Mediterranean and Middle East, or ICAS-EMME 3 for short. We are proud to host nearly 140 presentations on a wide range of topics and in 12 Thematic Sessions, covering all aspects of Archaeological Science, focused on the Eastern Mediterranean and the Middle East region. The number of presentations received was such that we had to split the conference into two parallel sessions, and to ask numerous colleagues to present their research as posters instead of oral presentations. This conference, after all the problems the pandemic caused, is held in a hybrid mode, with most participants being present at the premises of the Cyprus Institute. Through the social events organised, we hope to facilitate the interaction of speakers and audiences across the thematic sessions to counteract the separation due to parallel sessions and all the problems the pandemic caused in scientific meetings the last two years. In addition, the online streaming of the parallel sessions targets to reach wider audiences interested in the archaeology of the EMME region.

The main aim of this series of conferences is to cross borders, to combine innovation in methods with original research questions, to break out from a strict disciplinary focus, and to offer more comprehensive views on the lives and times of people's past, regardless of whether the evidence we study and discover emerges from the soil through excavation, or has been kept above ground.

We are thrilled that almost for each session we were able to attract a senior scholar from outside Cyprus to be the chair, together with one of our own academics at the Science and Technology in Archaeology and Culture Research Center (STARC) at the Cyprus Institute.

The Hellenic Society for Archaeometry (HSA) is the largest and longest-established relevant professional organisation in the Eastern Mediterranean, providing a forum for colleagues not only in Greece to exchange ideas and information, and promoting the application of Science and Technology in Archaeology, History of Art and Cultural Heritage. We are pleased and honoured that the President of the HSA, Prof. Yorgos Facorellis accepted our invitation to present a Public Keynote Lecture on the third day of ICAS-EMME 3.

A conference such as this doesn't pop into existence just like that. It took numerous people and organisations to make this happen, and each and every one whom we asked has offered generously of their time, experience, and contacts. We are also proud that this event has come together as a joint effort from across the archaeological community in Cyprus. While the Cyl acted as the nucleus and physical host of the event, our friends and colleagues of the Archaeological Research Unit of the University of Cyprus and the Cyprus American Archaeological Research Institute have enthusiastically accepted our invitation to co-organise ICAS-EMME 3, and the Department of Antiquities not only encouraged us with our combined effort, but also very generously offered the guided tour of the Cyprus Museum for our international visitors on Friday morning.

Special mention should be made of the A.G. Leventis Foundation. Since their inception they have been the leading philanthropic organisation supporting archaeological and cultural heritage work in Cyprus, and Cypriot Archaeology and Heritage worldwide. Their endowment of the A.G. Leventis Chair in Archaeological Sciences at the Cyprus Institute in 2018 was a key enabler of this conference, and we are most grateful for their enduring support of our common cause. The extraordinary generosity of the Foundation towards all of us cannot be over-emphasized, and is deeply appreciated.

Funding for the conference was provided by the Cyprus Institute as well as by the European Union through the H2020 project [Promised](#) - *Promoting Archaeological Science in the Eastern Mediterranean*. This Twinning project links the Cyprus Institute with advanced experienced partners at the University of Cambridge and the KU Leuven. Among the activities organised under [Promised](#) are Short Courses, Summer Schools, mentoring and training visits, and public outreach events in Cyprus, the UK and Belgium - and the organization of ICAS-EMME 3.

Several sponsors supported this conference such as the Honor Frost Foundation, Elsevier and the Society for Archaeological Sciences. They kindly offered travel subsidies and prizes for best oral and poster presentations to support early stage researchers and post graduate students, and for this we cordially thank them. In addition, the conference provided several Travel Bursaries to support postgraduate students attend the conference in person.

Finally, on behalf of the Organising Committee we want to thank all those who made the conference happen on a practical level, particularly Dr Evi Margaritis, Andriani Loui and Melanie Kitt, with further support from the various offices of the Cyprus Institute, and many more.

Thilo Rehren and Artemios Oikonomou

PROGRAM

Monday 14/03/2022

19:00-21:00 Pre-Registration - Welcoming reception at the Cyprus American Archaeological Research Institute (CAARI)

Tuesday 15/03/2022

09:00-09:30	Opening ceremony	
	Session 1 Archaeological Science studies in the EMME region <i>Session chairs: Prof. Apostolos Sarris</i> NTL Building	Session 2 Mediterranean palaeomobility: written sources, material networks and skeletal data <i>Session chairs: Dr Efthymia Nikita and Prof. Cyprian Broodbank</i> ANNEX Building
09:30-09:50	01.1. Neolithic plaster floors at Motza: Earliest case of burning dolomite for plaster? Yonah Maor , Hamoudi Khalaily , Jacob Vardi , Yotam Asscher	02.1. Hala Sultan Tekke, Cyprus: Interregional interactions in the Late Bronze Age Peter Fischer
09:50-10:10	01.2. Identifying properties of ancient lime mortars in the Roman baths of Tyre, Lebanon Ali Khalil Badawi , Aurelia Badde , André Gardei , Linda Hakim , Bernhard Illerhaus , Dietmar Meinel	02.2. Isotopic assessment of the diverse burial sample from Late Helladic and Protogeometric Mitrou and Tragana-Agia Triada Nicholas Herrmann , Stephanie Fuehr , Aleydis Van de Moortel
10:10-10:30	01.3. Geoarchaeology of prehistoric Cypriot architecture. Integrated analyses of mudbricks from Middle Bronze Age Erimi Marialucia Amadio , Luca Bombardieri	02.3. Diet and population admixture at Colonia Iulia Augusta Diensis (Dion) Paraskevi Tritsaroli , Evagelia Alvanou , Michael Dee , Dimitris Filioglou , Sofia Voutsaki
10:30-11:00	Coffee break	

Tuesday 15 March

Session 1 | Archaeological Science studies in the EMME region
Session chairs: Prof. Apostolos Sarris

NTL Building

- 11:00-11:20** **O1.4.** | An application of point pattern analysis and spatial statistics in lithic distributions | [Anastasia Eleftheriadou](#)
- 11:20-11:40** **O1.5.** | Island metallurgy: Investigation of Cypriot metal objects in the collection of The Fitzwilliam Museum, Cambridge | [Susanna Pancaldo](#), [Jana Mokrisova](#), [Ema Bauzyte](#)
- 11:40-12:00** **O1.6.** | Assessing the iron-working skills at Roman Judaea: An archaeometallurgical study of two Bar-Kokhba revolt assemblages from Israel | [Yarden Pagelson](#), [Peter Fabian](#), [Yuval Goren](#)
- 12:00-12:20** **O1.7.** | Osmium isotope analysis as an innovative tool for provenancing ancient iron: Application for sourcing Iron Age objects in the southern Levant | [Adi Eliyahu-Behar](#), [Naama Yahalom-Mack](#), [Michael Brauns](#)

12:30-14:00
Lunch and Poster Session
Session 1 | Archaeological Science studies in the EMME region
Session chairs: Prof. Yorgos Facorellis

NTL Building

- 14:00-14:20** **O1.8.** | Collagen extraction and evaluation of organic preservation in skeletal material from the Neolithic settlement in Dispilio, Greece | [Iliopoulos Dimitris](#), [Stathopoulou Elizabeth](#)
- 14:20-14:40** **O1.9.** | Before they were Kings: an interdisciplinary study of consumption practices in the Ayios Vasileios North Cemetery (Laconia) | [Maria Roumpou](#), [Efrossini Vika](#), [Vasco Hachtmann](#), [Sofia Voutsaki](#)
- 14:40-15:00** **O1.10.** | Archaeobotanical perspectives from two thousand years at Tell es-Safl Gath | [Suembikya Frumin](#), [Ehud Weiss](#)

Session 2 | Mediterranean palaeomobility: written sources, material networks and skeletal data
Session chairs: Dr Efthymia Nikita and Prof. Cyprian Broodbank

ANNEX Building

- O2.4.** | Mobility and connectivity in early Roman Crete: the evidence from the tombs and the scope for further skeletal investigation | [Anna Moles](#)
- O2.5.** | Mobility in Roman Phoenicia: A biodistance study | [Mahmoud Mardini](#), [Ali Badawi](#), [Tania Zaven](#), [George Doumit](#), [Mohana Chahine](#), [Efthymia Nikita](#)
- O2.6.** | Stowaway: A Ship Rat's Journey | [Sierra Harding](#), [Ardern Hulme-Beaman](#), [Deborah Cvikel](#), [Nimrod Marom](#)
- O2.7.** | SrIsoMed: An open access database for Sr isotopes across the Mediterranean | [Efthymia Nikita](#), [Mahmoud Mardini](#), [Patrick Degryse](#)

Session 3 | Copper metallurgy in the EMME
Session chairs: Prof. Thilo Rehren, Dr Myrto Georgakopoulou and Prof. Vasiliki Kassianidou

ANNEX Building

- O3.1.** | Copper alloys in the Early Bronze Age Aegean | [Myrto Georgakopoulou](#), [Liana Filippaki](#), [Yannis Bassiakos](#)
- O3.2.** | Early zinc metallurgy in Urartu: Recent evidence from eastern Anatolia | [Ümit Güder](#), [Abdulkadir Özdemir](#), [Marek Vercik](#)
- O3.3.** | From the north to the south, metals all around: Alloying in the prehistoric Bronze Age sites of Bellapais-Vounous and Kalavassos-Village, Cyprus | [Andreas Charalambous](#), [Rafael Laoutari](#)

15:00-15:20	01.11. Study and Investigations of Archaeobotanical remains from Tutankhamun tomb NagmEldeen Morshed Hamza	03.4. Metal-making strategies and technological skills in 2 nd Millennium BCE western Anatolia: New archaeometric data from the LBA citadel of Kaymakçı Dalila Alberghina
15:30-16:00	Session 1 Archaeological Science studies in the EMME region <i>Session chairs: Prof. Yorgos Facorellis</i> NTL Building	Coffee break Session 3 Copper metallurgy in the EMME <i>Session chairs: Prof. Thilo Rehren, Dr Myrto Georgakopoulou and Prof. Vasiliki Kassianidou</i> ANNEX Building
16:00-16:20	01.12. Variations of the geomagnetic field during the second and first millennia BCE through the study of Greek pottery: impact for archaeology Despina Kondopoulou , Mercedes Rivero-Montero , Miriam Gomez-Paccard , Elina Aidona	03.5. Recording the copper slag heaps in the hinterland of the kingdom of Palaepaphos Vasiliki Kassianidou , Andreas Charalambous , Demetrios Ioannides , Maria Iacovou , Athos Agapiou , Zomenia Zomeni
16:20-16:40	01.13. Minor marble objects and trade networks. The case study of Meter reliefs from Ephesos Vasiliki Anevlavi , Sabine Ladstätter , Walter Prochaska	03.6. Cutting edge metallurgy: Blade technology in the Late Bronze Age Carpathian basin (The Fall of 1200 BC) Vana Orfanou , Barry Molloy
16:40-17:00	01.14. Is there something missing in provenance studies of ancient marble? Khaled Al-Bashaireh	03.7. New Insights on the provenance studies of the Bronze Age copper-based objects from south-western Iran Omid Oudbashi , Virginie Renson , Reza Naseri
17:00-17:20	01.15. Blue my mind: the discovery and experimental production of Persian blue Rahil Alipour , Thilo Rehren	03.8. Lead isotope analysis for provenancing: different perspectives explored through a case study on Roman Republican silver coins Sarah De Ceuster , Dimitra Machaira , Patrick Degryse
17:20-17:40	01.16. Fragments of luxury: Glass findings from the Palace of Mystras Eleni Palamara , Vasiliki Valantou , Dimitrios Palles , Efstratios Kamitsos , Nikolaos Zacharias	
18:00-19:00		Round Table: Moving and Mixing: Mobility, Theory and Provenance

POSTER SESSION**NTL Building**

P1.1. | A bridge between Science and Archaeology in studying Tutankhamun's collection | [NagmEldeen Morshed Hamza](#)

P1.2. | Contextualizing and interpreting biological distance from dental metric data at Oymaağaç, Turkey (1st c. BCE-2nd c. CE) | [Kathryn Marklein](#), [Madelyn Green](#)

P1.3. | An updated chronology of Tepe Sialk in Iran, based on OSL and C14 dating | [Hassan Fazeli Nashli](#), [Katerina Theodorakopoulou](#), [Kostas Stamoulis](#), [Constantin Athanassas](#), [Hamid Nazari](#), [Sepideh Jamshidi Yeganeh](#), [Jebraeil Nokandeh](#)

P1.4. | Archaeobotany in Tinos Island: A preliminary test of applicability | [Thorsten Jakobitsch](#), [Vangelis Samaras](#), [Konstantinos Pantzouris](#), [Anastasia Angelopoulou](#)

P1.5. | Plaster, cartonnage, and the making of Egyptian coffins: project overview | [Caterina Zaggia](#), [Marcos Martinon-Torres](#), [Matthew Collins](#), [Helen Strudwick](#), [Julie Dawson](#)

P1.6. | Thouria Lagynos: An organic residue study | [Delaney Brink](#), [Stamatis Boyatzis](#), [Nikolaos Zacharias](#)

P1.7. | XRF Analysis of 16 Hellenistic coins: An archaeometric approach to bronze alloys of Ancient Messene coinage | [Artemis Kampa](#), [Eleni Palamara](#), [Nikolaos Zacharias](#)

P3.1. | Bronze Age copper production at Hala Sultan Tekke, Cyprus: First archaeometallurgical results | [Mathias Mehofer](#), [Teresa Bürge](#), [Peter Fischer](#)

P3.2. | The archaeometallurgical transition from Neolithic to Chalcolithic Period in northern Iranian Plateau: Some pieces of evidence from Tappeh-Zaghe and Tappeh-Ghabristan | [Sepehr Bahadori](#), [Omid Oudbashi](#), [Mathias Mehofer](#), [Ahmad Aliyari](#)

P3.3. | EBA metal objects from Mesi Glyfada sea, Northern Aegean, Greece: preliminary data | [Athina Nikolopoulou](#), [Eleni Philippaki](#)

P3.4. | Investigating two late Roman slag heaps in the area of Polis Chrysochous, Cyprus | [Anna Maria Sdralia](#), [Vasiliki Kassianidou](#), [Thilo Rehren](#), [Apostolos Sarris](#)

P3.5. | Lime-rich bloomery slags from lime poor ores | [Meghna Desai](#), [Thilo Rehren](#)

P3.6. | From OXALID to GlobalID: A substantial upgrade of a well-known data pool of lead isotopes for metal provenancing using R and Shiny App | [Thomas Rose](#), [Sabine Klein](#), [Katrin Westner](#), [Yiu-Kang Hsu](#)

Wednesday 16/03/2022

Session 4 | An Environmental History of ancient Cyprus: landscapes, plants and animals through time

Session chairs: Dr Evi Margaritis, Dr Angelos Hadjikoumis and Prof. Paul Halstead

NTL Building

- 09:00-09:20** **04.1.** | Have Cypriots ever tasted hippo meat? A short presentation of the Cypriot pygmy hippo and the extinction scenarios | [Loucas Nicolaou](#), [George Iliopoulos](#), [Socrates Roussiakis](#)
- 09:20-09:40** **04.2.** | From hippos to cattle: the fragile relationship of early Cypriots with their animals | [Alan Simmons](#)
- 09:40-10:00** **04.3.** | Historical dynamics of the human-environment interactions in Cyprus during the 10th-8th millennia cal BC: the last 30 years contributions of the Amathous area (Limassol district) | [Jean-Denis Vigne](#), [Salvador Bailon](#), [Isabelle Carrère](#), [Thomas Cucchi](#), [Benoît Devillers](#), [Carolyne Douché](#), [Lionel Gourichon](#), [Angelos Hadjikoumis](#), [Pantelitsa Mylona](#), [Katerina Papayiannis](#), [Andréa Parès](#), [Maria Rousou](#), [Margareta Tengberg](#), [Antoine Zazzo](#), [Jean Guilaine](#), [François Briois](#)
- 10:00-10:20** **04.4.** | Mesopotamian fallow deer and the chase in Neolithic Cyprus: Insights from Upper Mesopotamia, the Levant and greater Syrian desert | [Alexander Wasse](#)

Session 6 | Scientific Analysis of Ancient Glass in the EMME region

Session chairs: Dr Artemios Oikonomou and Dr Daniela Rosenow

ANNEX Building

- 06.1.** | Exploring Mycenaean glass world via a combination of state-of-the-art techniques | [Maria Kaparou](#), [Kalliopi Tsampa](#), [Nikolaos Zacharias](#), [Andreas Karydas](#)
- 06.2.** | Preliminary spectroscopic results on glass circulation in the Iron Age Mediterranean from the perspective of Central Italy: the INGOT-EL project | [Oleh Yatsuk](#), [Astriak Gorghinian](#), [Giacomo Fiocco](#), [Patrizia Davit](#), [Serena Francone](#), [Alessandra Serges](#), [Leonie Koch](#), [Alessandro Re](#), [Alessandro Lo Giudice](#), [Marco Ferretti](#), [Marco Malagodi](#), [Christiano Iaia](#), [Monica Gulmini](#)
- 06.3.** | New analytical investigation of material from the fourth century CE glass workshop at Jalame, Israel | [Gry Barfod](#), [Chen Chen](#), [Ian Freestone](#), [Katherine Larson](#), [Yael Gorin-Rosen](#)
- 06.4.** | Chemical analysis of Roman-Byzantine glass artifacts and Islamic bracelets from the archaeological site of Dohaleh, north Jordan | [Khaled Al-Bashaireh](#), [Ian Freestone](#), [Tom Gregory](#)

10:30-11:00

Coffee break

Session 4 | An Environmental History of ancient Cyprus: landscapes, plants and animals through time

Session chairs: Dr Evi Margaritis, Dr Angelos Hadjikoumis and Prof. Paul Halstead

NTL Building

- 11:00-11:20** **04.5.** | Breaking bread: a review of early Cypriot prehistoric cooking traditions | [Leilani Lucas](#)
- 11:20-11:40** **04.6.** | Agia Marina. New paleoenvironmental insights from the Aceramic Neolithic of south-western Cyprus | [Eugenio Di Valerio](#), [Claudia Speciale](#)
- 11:40-12:00** **04.7.** | What's different in 2nd millennium agriculture in Cyprus | [Evi Margaritis](#), [Carly Henkel](#), [Luca Bombardieri](#), [Joachim Bretschneider](#), [Jan Driessen](#), [Athanasia Kanta](#), [Sturt Manning](#), [Despo Pilides](#)
- 12:00-12:20** **04.8.** | Olive trade in the Eastern Mediterranean: assessing varietal diversity and cultivation origin of olive (*Olea europaea*) from the Mazotos shipwreck (4th c. BCE) using geometric morphometrics | [Clémence Pagnoux](#), [Evi Margaritis](#), [Vincent Bonhomme](#), [Stella Demesticha](#), [Sarah Ivorra](#), [Kyriaki Tsirtsis](#), [Jean-Frédéric Terral](#)

12:30-14:00

Lunch and Poster Session

Session 4 | An Environmental History of ancient Cyprus: landscapes, plants and animals through time

Session chairs: Dr Evi Margaritis, Dr Angelos Hadjikoumis and Prof. Paul Halstead

NTL Building

- 14:00-14:20** **04.9.** | Bronze Age landscape use and herding practices at Politiko-Troullia, Cyprus | [Suzanne Pilaar Birch](#), [Elizabeth Ridder](#), [Mary Metzger](#), [Steven Porson](#), [Patricia Fall](#), [Steven Falconer](#)
- 14:20-14:40** **04.10.** | Some comments on the unpublished fauna from Enkomi-Ayios Iakovos (Dikaiois excavations, 1948-58) | [David Reese](#)

Session 6 | Scientific Analysis of Ancient Glass in the EMME region

Session chairs: Dr Artemios Oikonomou and Dr Daniela Rosenow

ANNEX Building

- 06.5.** | Furnace linings, glass chunks and contamination processes in Byzantine glass production at Apollonia, Israel | [Chen Chen](#), [Ian Freestone](#), [Jessica Barnes](#), [Tom Gregory](#), [Ruth Jackson-Tal](#), [Oren Tal](#)
- 06.6.** | Metal prills in primary glass: a puzzling additive to the production process | [Artemios Oikonomou](#), [Yotam Asscher](#), [Yael Gorin-Rosen](#), [Thilo Rehren](#)
- 06.7.** | Glass from the Silk Roads. Insights into new finds from Kafir Kala (Samarkand, Uzbekistan) | [Tania Chinni](#), [Sara Fiorentino](#), [Alberta Silvestri](#), [Simone Mantellini](#), [Amriddin Berdimuradov](#), [Mariangela Vandini](#)
- 06.8.** | The Gulf between glass: Using various advances in glass analytical approaches to trace the origins and distributions of Islamic glass bangles across the Gulf region, Middle East and beyond (9th-18th centuries CE) | [Charlotte Nash](#)

Session 7 | Multimodal Digital Heritage Preservation in the EMME Region

Session chairs: Dr Dante Abate, Prof. Eva Savina Malinverni, Dr Roberto Pierdicca

ANNEX Building

- 07.1.** | Multimodal digital documentation of a 20th century wooden vessel at risk: the AGIOS SPYRIDON project | [Stella Demesticha](#), [Irene Katsouri](#), [Massimiliano Secci](#), [Kostas Damianidis](#), [Georgios Tzavaras](#), [Marina Faka](#), [Dante Abate](#), [Constantinos Nikolaou](#), [Georgia Kyriakou](#), [Nikolas Bakirtzis](#)
- 07.2.** | Multi-Sensor documentation of the inaccessible Nicosia International Airport located in the UN controlled Buffer Zone of Cyprus. The NIC Project | [Dante Abate](#), [Marina Faka](#), [Andreani Papageorgiou](#), [Antonia Agapiou](#)

14:40-15:00	04.11. Animals and plants on ancient Cypriote coins Evangeline Markou	07.3. Documenting and reconstructing gaming heritage from antiquity to today Walter Crist , Cameron Browne
15:00-15:20	04.12. River and societies in Medieval Cyprus: the case of the Xeros River in Larnaca district Pantelitsa Mylona , Athanasios Vionis , Benoît Devillers	07.4. The dynamic digital survey. Integration between digital processes for the documentation of some monasteries in the Gjirokastra area Michele Calvano , Alban Gorreja , Awal Rahali , Luciano Cessari , Eva Savina Malinverni , Elena Gigliarelli
15:20-15:40		07.5. The archaeological site of Umm er-Rasas: innovative technologies and training activities for the conservation and enhancement Roberto Gabrielli , Roberto Pierdicca , Fabio Piccinini , Eva Savina Malinverni
15:30-16:00	Coffee break	
	Session 5 Modelling Settlement Transformations in the EMME region <i>Session chairs: Dr George Artopoulos, Dr Katherine Crawford and Dr Iza Romanowska</i> NTL Building	Session 8 Digital documentation of heritage and the participation of local communities <i>Session chairs: Dr Sorin Hermon, Dr Mia Trentin and Dr Anna Foka</i> ANNEX Building
16:00-16:20	05.1. EIDOS of a city: simulating the collapse and resilience of ancient Eastern Mediterranean urban environments via agent-based modelling Katherine Crawford , Iza Romanowska , Georgios Artopoulos	08.1. Depicting the past: The value of old maps and topographic diagrams in cultural heritage through GIS Rebecca Grethe , George Malaperdas , Nikolaos Zacharias
16:20-16:40	05.2. Meta-population theory for settlement pattern analysis: Movement, Colonization, and Depopulation, in 16 th -20 th centuries Galilee Ido Wachtel , Roi Zidon , Yair Greenberger , Uri Davidovich	08.2. Reconstructing the memory of the Arsinoe excavation in Egypt. Processes of 3D modelling for the valorization of the archaeological activities of the "G. Vitelli" Papyrological Institute between 1964 and 1965 in Arsinoe Sandro Parrinello
16:40-17:00	05.3. Patterning pastoral nomadism: MaxEnt modeling of Bedouin sites in the Judean Desert Uri Davidovich , Ido Wachtel , Roi Zidon	08.3. The Roman necropolis of Porta Palio in Verona. Rediscovery of the missing places through interactive three-dimensional models Francesca Galasso
17:00-17:20	05.4. A fast parametric approach to model historical city blocks: from geodata to H-BIM Federico Mario La Russa , Mariateresa Galizia , Cettina Santagati	08.4. A 3D High-Resolution Model of an Inner Mani War Tower Stavroula Xarchakou , Vayia Panagiotidis , Nikolaos Zacharias

17:20-17:40**08.5.** | A tool for quantitative research on the social awareness for the digitization of cultural heritage: A pilot application | [Nikolaos Trivyzadakis](#)**18:00-19:00****Invited Guest Lecture** | The fluctuation of the marine reservoir effect in the Aegean Sea during the last 13,000 years cal BP and its implications in the radiocarbon dating | [Prof. Yorgos Facorellis](#), President of the Hellenic Society of Archaeometry (HSA)**20:30****Conference Dinner****POSTER SESSION****NTL Building****P4.1.** | Isotopic analysis of pygmy hippo's fossil bone and tooth apatite from Aghia Napa, Cyprus | [Maria Anna Nakasi](#), [Elizabeth Stathopoulou](#), [Petros Karalis](#), [Maria Tassi](#), [Elissavet Dotsika](#), [Georgios Theodorou](#)**P4.2.** | Tooth enamel microstructure of the dwarf hippo *Phanourios minor* from Aghia Napa, Cyprus | [Vasileios Noulis](#), [Elizabeth Stathopoulou](#) and [Georgios Theodorou](#)**P4.3.** | Macro- and micro- botanical remains hand in hand: the cases of Bronze Age Alambra-Kato Lakkos and Agios Sozomenos-Ampelia (Cyprus) | [Kyriaki Tsirtsis](#), [Carly Henkel](#), [Juan José García-Granero](#), [Evi Margaritis](#), [Efthymia Elston Alphas](#), [Despina Pilides](#)**P11.2.** | The iconostasis of Panagia Damasta: pigments identification in icons using N.D.T. | [Stella Mouzakiotou](#), [Theodore Ganetsos](#)**P8.1.** | The use of remote sensing and GIS in Archaeology | [Sirine Saad El-Dine Ghiye](#)**P8.2.** | Ancient glass burial offerings of children inhumations from modern east Locris (Phthiotis-Greece): Scientific analysis of ancient glass | [Maria Papageorgiou](#), [Theodore Ganetsos](#), [Kyriaki Christodoulou](#), [Konstantinos Brachos](#), [Stella Mouzakiotou](#), [Petros Stavroulakis](#)**P8.3.** | Antiquities in changing rural landscapes: Using satellite imagery and GIS in the regional survey of northern Messenia, Greece | [Eleni Vallianatou](#), [Eleni Zimi](#), [George Malaperdas](#)

Thursday 17/03/2022
Session 9 | Interdisciplinary ceramic studies as proxies for approaching Eastern Mediterranean societies of the 2nd and 1st millennia BC

Session chairs: Dr Maria Dikomitou-Eliadou, Dr Anna Georgiadou and Dr Artemis Georgiou

NTL Building

09:00-09:20 **09.1.** | Pottery production and circulation at Middle Bronze Age Heraion on Samos, Greece: A preliminary petrographic analysis | [Sergios Menelaou](#), [Ourania Kouka](#)

09:20-09:40 **09.2.** | A diachronic study of culinary practices and pottery use in Minoan Crete: an integrated approach in cooking vessels from Sissi and Malia | [Maria Roumpou](#), [Evgenia Tsafou](#)

09:40-10:00 **09.3.** | Pottery traditions in Kydonia: results from the petrographic analysis of Late Bronze Age ceramic assemblages from Chania, Crete | [Stavroula Fouriki](#), [Eleni Nodrou](#)

10:00-10:20 **09.4.** | Combined approach to production and distribution of White Ware towards the end of Late Bronze Age in Greece | [Bartłomiej Lis](#), [Hans Mommsen](#), [Johannes Sterba](#)

10:30-11:00

Coffee break

Session 9 | Interdisciplinary ceramic studies as proxies for approaching Eastern Mediterranean societies of the 2nd and 1st millennia BC

Session chairs: Dr Maria Dikomitou-Eliadou, Dr Anna Georgiadou and Dr Artemis Georgiou

NTL Building

11:00-11:20 **09.5.** | Through the pots of the “Sea Peoples”: Provenance studies of tableware from Late Bronze Age Hala Sultan Tekke | [Paula Waiman-Barak](#), [Teresa Bürge](#), [Peter Fischer](#)

11:20-11:40 **09.6.** | Kinet Höyük, a Cilician harbour and its Cypriot connections during the Iron Age | [Gunnar Lehmann](#), [Paula Waiman-Barak](#)

Session 11 | Art Characterization

Session chairs: Dr Nikolas Bakirtzis and Dr Svetlana Gasanova

ANNEX Building

011.1. | Pigment characterization of Maria Auersperg paintings of the 19th century from the collection of the National Museum of Slovenia | [Theodore Ganetsos](#), [Konstantina Romantzi](#), [Eva Menart](#), [Ziga Šmit](#)

011.2. | Identification of blue pigments in 18th century paintings from the collection of the Gallery of Matica srpska, Serbia | [Daniela Korolija Crkvenjakov](#), [Maja Gajić-Kvaščev](#), [Theodore Ganetsos](#), [Velibor Andrić](#)

011.3. | Non-invasive mineralogical interpretation of multiband imaging systems: Using spectral indicators in Multispectral Microscope for characterizing pigments of wall paintings | [Yotam Asscher](#)

011.4. | Creation of a replica of a medieval metal cross of the Maronite Church of the Holy Cross in Karpasia | [Marina Faka](#), [Agapios Agapiou](#), [Dante Abate](#), [Svetlana Gasanova](#), [Iosif Hadjikyriakos](#), [Nikolas Bakirtzis](#)

Session 11 | Art Characterization

Session chairs: Dr Nikolas Bakirtzis and Dr Svetlana Gasanova

ANNEX Building

011.5. | Investigation of paintings by scanning XRF | [Anastasios Asvestas](#), [Vasiliki Karamaligka](#), [Theofanis Gerodimos](#), [George Mastrotheodoros](#), [Dimosthenis Chatzipanteliadis](#), [Dimitris Anagnostopoulos](#)

011.6. | Interpretation of XRF spectral imaging data using dimensionality reduction combined with clustering algorithms | [Theofanis Gerodimos](#),

Giannis Chantas, Anastasios Asvestas, Aristidis Likas, Dimitris Anagnostopoulos

11:40-12:00 **09.7.** | Late Bronze-Early Iron age pottery from Doghlauri burial ground: understanding the Transcaucasian intercultural relations | [Nikoloz Gobejishvili](#), [Iulon Gagoshidze](#), [Kristine Shavlakadze](#), [Tinatin Chanishvili](#), [David Gagoshidze](#)

12:00-12:20 **09.8.** | Plaster technology in Iron Age Lebanon: the contribution of Tell el-Burak | [Silvia Amicone](#), [Adriano Orsingher](#), [Emma Cantisani](#), [Christoph Berthold](#), [Hélène Sader](#), [Aaron Schmitt](#), [Jens Kamlah](#)

011.7. | Implementing photogrammetry for the analysis of archaeological plasters | [Alice Clinch](#)

011.8. | Terahertz C-scans of the test object in the spectral range from 0.1 to 2.5 THz | [Olga Smolyanskaya](#), [Sergey Sirro](#), [Alexander Minin](#), [Vyacheslav Toropov](#), [Olga Kravtsenyuk](#), [Anastasiya Lykina](#), [Alessia Portieri](#), [Phil Taday](#), [Donald Arnone](#), [Jean-Paul Guillet](#), [Vincent Detalle](#), [Michel Menu](#)

12:30-14:00

Lunch and Poster Session

Session 9 | Interdisciplinary ceramic studies as proxies for approaching Eastern Mediterranean societies of the 2nd and 1st millennia BC

Session chairs: Dr Maria Dikomitou-Eliadou, Dr Anna Georgiadou and Dr Artemis Georgiou

NTL Building

Session 12 | Graduate Research in Archaeological Sciences in the EMME region

Session chairs: Meghna Desai, Carly Henkel, Anna. Karligioti, Mahmud Mardini, Mehmetcan Soyluoglu, Kyriaki Tsirtsis, Chryssa Vergidou and Dr Lindy Crewe

ANNEX Building

14:00-14:20 **09.9.** | An interdisciplinary study of ceramic loom weights from Archaic and Classical Corinth | [Carlotta Gardner](#), [Bela Dimova](#), [Noémi Müller](#), [Evangelia Kiriati](#)

14:20-14:40 **09.10.** | Pottery production in Iron Age Salamis, Cyprus. An interdisciplinary study of ceramic fabrics from the city and the periphery | [Maria Dikomitou Eliadou](#), [Anna Georgiadou](#), [Giorgos Papasavvas](#)

14:40-15:00 **09.11.** | Pottery production in Classical Athens through the looking glass: co-existing potting traditions, workshops and migrant potters | [Evangelia Kiriati](#), [Noémi Müller](#), [Edyta Marzec](#), [Gudrun Klebinder-Gauss](#), [Ann Steiner](#)

012.1. | Fire and bones: A multidisciplinary approach to the study of burned human remains | [Yiannis Chatzikonstantinou](#)

012.2. | From excavating bones to reconstructing funerary practices: contextualizing skeletal evidence for the post-funerary treatment of the dead at the Prepalatial and Protopalatial Petras cemetery (3000-1800 BCE), Siteia, Crete | [Sotiria Kiorpe](#)

012.3. | Breastfeeding and weaning patterns in ancient Thessaloniki through the analysis of incremental human dentine | [Elissavet Ganiatsou](#), [Efrossini Vika](#), [Aggeliki Georgiadou](#), [Tania Protosalti](#), [Christina Papageorgopoulou](#)

15:00-15:20	O9.12. Hellenistic and Roman fine wares from ancient Elis, Greece: A preliminary study using SEM/EDS analysis Elena Triantafyllidi , Eleni Zimi , Nikolaos Zacharias	O12.4. Where did the sheep go? Combining zooarchaeological and isotopic evidence to assess caprine mobility in Classical-Hellenistic Thessaly, central Greece Dimitris Filioglou , Wietske Prummel , Silvia Valenzuela-Lamas , Leopoldo Pena , William Patterson , Sandra Timsic , Canan Çakirlar
15:30-16:00	Coffee break	
	Session 10 Potting traditions of medieval and post-medieval Eastern Mediterranean <i>Session chairs: Dr Jelena Živković, Dr Athanasios Vionis and Dr Maria Dikomitou-Eliadou</i> NTL Building	Session 12 Graduate Research in Archaeological Sciences in the EMME region <i>Session chairs: Meghna Desai, Carly Henkel, Anna. Karligkioti, Mahmud Mardini, Mehmetcan Soyluoglu, Kyriaki Tsirtsis, Chryssa Vergidou and Dr Lindy Crewe</i> ANNEX Building
16:00-16:20	O10.1. The Maroneia cave in Aegean Thrace. Transport amphoras and plain pottery Anna Panti	O12.5. High-resolution approaches to climatic variability using shell proxies from Franchthi, Greece Danai Theodoraki
16:20-16:40	O10.2. The handmade wares of Crusader-Mamluk Bilad al-Sham: Agents of affiliation or demarcation? Ruth Smadar Gabrieli	O12.6. Deciphering formation processes and human activities at the Neolithic lakeside settlement of Dispilio, Greece: A micro-geoarchaeological approach Ioannis Oikonomou
16:40-17:00	O10.3. A pottery context of the Mamluk period (half 13 th -14 th century) from the so-called Herod's House in the Monastery of Flagellation-Jerusalem Tiziana Guerrieri	O12.7. Effective management of archaeological and historical shipwreck sites in the Red Sea, Egypt Alicia Johnson
17:00-17:20	O10.4. Potting traditions of post-medieval Cyprus: archaeological and scientific view on consumption and production patterns Jelena Živković	O12.8. Fishing activity in Cyprus through time: an archaeologically neglected aspect of Cypriot society Maria Michael
17:30-18:30		Round Table: Challenges and opportunities in Graduate Research in the EMME region
18:30	Closing ceremony	

POSTER SESSION

NTL Building

P9.1. | Late Hellenistic trade networks through the lens of fine ware pottery from Delos | [Edyta Marzec](#), [Małgorzata Kajzer](#), [Jean-Sébastien Gros](#), [Noémi Müller](#), [Evangelia Kiriati](#)

P9.2. | A multi-disciplinary approach to differentiating between Classical fine ware pottery from Sikyon and Corinth | [Noémi S. Müller](#), [Carlotta Gardner](#), [Giorgos Giannakopoulos](#), [Kyriaki Tsirtsi](#), [Zoe Spyrali](#), [Marie-Louise Jahn Hansen](#), [Evangelia Kiriati](#)

P10.1. | New reflections on post-Roman apiculture in the Western Messarà (Crete) | [Colette Manciero](#)

P10.2. | Investigations on pottery use in late antique and mid-Byzantine Hierapolis (Phrygia, Turkey) by organic residue analyses | [Florinda Notarstefano](#)

P11.1. | Non-destructive study of a 19th century printed silk scarf from the collection of the National Historical Museum of Greece | [Nicoletta Tasiouli](#), [Stamatios Boyatzis](#), [Anna Karatzani](#), [Andreas Karydas](#)

P12.1. | Age-estimation of cremated bones: An histomorphological analysis | [Panagiota Bantavanou](#), [Efstratios Valakos](#), [Christina Papageorgopoulou](#)

P12.2. | Preliminary investigation of an indigenous Sicilian village: the case of Sant'Angelo Muxaro in the first millennium BCE | [Antonio Caruso](#), [Domenica Gulli](#), [Efthymia Nikita](#)

P12.3. | Diet reconstruction of the population of ancient Ambracia during the Archaic and Classical period: Stable isotope analysis ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) from bone collagen of human skeletons | [Aggeliki Georgiadou](#), [Elissavet Ganiatsou](#), [Kyriakos Xanthopoulos](#), [Tasos Zisis](#), [Varvara Papadopoulou](#), [Christina Papageorgopoulou](#)

P12.4. | Diet in the Roman province of Macedonia: implications from the isotopic evidence | [Chryssa Vergidou](#), [Sofia Voutsaki](#), [Efthymia Nikita](#), [Dee Mike](#)

P12.5. | Dental health in Roman Phoenicia: a comparative study | [Mahmoud Mardini](#), [Ali Badawi](#), [Tania Zaven](#), [George Doumit](#), [Mohana Chahine](#), [Efthymia Nikita](#)

P12.6. | Ottoman-era Cyprus: a bioarchaeological comparative study | [Mahmoud Mardini](#), [Anna Karligkoti](#), [Polina Christofi](#), [Efthymia Nikita](#)

P12.7. | Approaching diachronic life (ine)quality and identity formation in eastern Attica from the Classical to the Roman era | [Anna Karligkoti](#), [Kerasia Douni](#), [Olga Kakavogianni](#), [Maria Mexi](#), [Panagiota Michailidou](#), [Ekaterini Petrou](#), [Magdalini Vasileiadou](#), [Efthymia Nikita](#)

P12.8. | Day-to-day rural life during the Classical period. The case of Sikyon, Greece | [Kyriaki Tsirtsi](#), [Evi Margaritis](#), [Silke Muth-Frederiksen](#), [Konstantinos Kissas](#)

P12.9. | What's in the pottery? Designing a sampling strategy for the compositional and technological study of Late Chalcolithic pottery from Cyprus | [Maria Hadjigavriel](#)

P12.10. | Petrographic analysis of Chalcolithic pottery from Chlorakas-Palloures, Cyprus: A pilot study | [Stamatis Vogiatzopoulos](#)

P12.11. | An interdisciplinary study of cooking ware and practices at Toumba Thessaloniki, central Macedonia, from the Late Bronze to the Early Iron Age | [Timothée Ogawa](#), [Noémi Müller](#), [Haris Procopiou](#), [Sevasti Triantafyllou](#), [Stelios Andreou](#), [Evangelia Kiriati](#)

P12.12. | Understanding Greek Colonisation through material culture: pottery production and consumption in Campania during the 8th and the 7th centuries BC. Project Overview | [Marcella Giobbe](#), [Irene Lemos](#), [Matteo D'Acunto](#), [Teresa Cinquantaquattro](#), [Evangelia Kiriati](#)

P12.13. | Container and content: integral analyses of Mediterranean amphorae. Project overview | [Ismael Rodríguez Palomo](#), [Marcos Martín-Torres](#), [Matthew Collins](#)

P12.14. | Architectural Innovation in Cycladic Settlements during Early Bronze Age in the light of the recent excavations at Dhaskalio | [Marie Floquet](#), [Michael J. Boyd](#), [Colin Renfrew](#)

P12.15. | Geometry of power: Axis-nexus through type-grafo-metric analysis on Mesopotamian stelae | [Job Jiménez Hidalgo](#)

P12.16. | A biography of a traditional rural house from Ayios Amvrosios: Tree-ring research opportunities in a rural landscape | [Mehmetcan Soyluoglu](#)

P12.17. | Application of computed tomography for the characterization of historical footwear | [Arentona Fostiropoulou](#), [Anna Karatzani](#)

Friday 18/03/2022

- 10:00-11:00** Guided tour at the STARC laboratories
- 12:00-14:00** Guided tour at the Cyprus Archaeological Museum
- 16:00-18:00** Nicosia city walk. Guided tour inside the walls of old Nicosia

Public Keynote Lecture

Prof. Yorgos Facorellis

President of the Hellenic Society for Archaeometry HSA

The fluctuation of the marine reservoir effect in the Aegean Sea during the last 13,000 years cal BP and its implications in the radiocarbon dating

Yorgos Facorellis

Department of Antiquities and Works of Art Conservation, Faculty of Applied Arts and Culture, University of West Attica, Ag. Spyridonos, 12243, Greece

Abstract

It is very well known that the specific ^{14}C content of the marine reservoir differs from that of the atmosphere due to global carbon cycling. This effect generally results in a difference of about 400 years between the radiocarbon ages of contemporaneous terrestrial and marine organisms (from depths less than 75 m) with the latter usually being older. However, the magnitude of this effect may differ from region to region due to upwelling of long-residence-time deep waters, which can occur based on various factors that include coastline shape, climate and sea-bottom topography. One method to calculate the regional marine reservoir effect $R(t)$ is to radiocarbon date contemporaneous charcoal-sea shell paired samples that have been collected from undisturbed archaeological layers. Then a local reservoir correction ΔR can be determined and used thereafter in conjunction with the international marine calibration curve to reliably convert the conventional radiocarbon ages to calendar ones for the marine samples from the specific region.

Archaeological excavations in thirteen so far coastal archaeological sites have provided suitable material to estimate changes of the sea surface radiocarbon marine reservoir effect in the Aegean Sea from ca 13,000 years cal BP till present. In total fifty-six atmospheric-marine pairs of samples were radiocarbon dated. Their ^{14}C ages were calibrated using the latest versions of IntCal20 and Marine20 international calibration curves, which allowed the calculation of the reservoir ages $R(t)$ and regional deviations ΔR during the studied period. Our results show that their values are not constant through time and may vary significantly. In addition, they have provided the framework and justification for more comprehensive and larger-scale studies emphasizing on palaeoclimate and palaeoceanography, which may yield a comprehensive marine reservoir correction curve for the entire Aegean Sea region. The latter could be used for the reliable calibration of marine origin samples and human bones from individuals based on mixed diet.

Archaeological Science studies in the EMME region

Session chairs: Prof. Apostolos Sarris, Prof. Yorgos Facorellis

Oral presentations

Neolithic plaster floors at Motza: Earliest case of burning dolomite for plaster?

Yonah Maor⁽¹⁾, Hamoudi Khalaily⁽¹⁾, Jacob Vardi⁽¹⁾ and Yotam Asscher⁽¹⁾

(1) *Israel Antiquities Authority, Rockefeller Museum, Post Office Box 586, Jerusalem, 91004.*

Abstract

Plaster production was a great technological development of the early Neolithic periods in the southern Levant. Previous research has reported the use of either calcite or gypsum as a binder with additions of local stone or sediment as aggregates. In cases where dolomite was present, it was used in its native form, unfired. Analysis of the Motza plasters showed that both calcite and dolomite were fired for plaster making.

Dolomite requires a lower firing temperature than calcite and a longer hydration period, but if done correctly it can produce plaster that is even stronger and more water resistant than calcitic plaster. In Motza we found evidence of separate burning pits for calcite and dolomite, suggesting the Neolithic population there had found how to identify the two stones and fire each to a suitable temperature.

Motza plasters and potential source materials were analyzed by FTIR, XRD, SEM and thin section microscopy. A new FTIR method was developed to assess the amount of dolomite and the degree of disorder in the dolomite, to show it has been decarbonized and reformed as plaster. In addition, experimental plaster was prepared, showing the segregation of magnesium rich areas like those seen in the Neolithic plaster and suggesting the mechanism of reforming dolomite in ancient dolomitic plasters.

The well-preserved plaster floors at Motza typically feature a preparation layer with a binder that is a mix of calcite and dolomite and a topcoat of pure white calcite. This shows the two plaster technologies were intentionally used for different purposes. There was consistent use of these same practices across the large site and over several occupation layers, all during the Pre-pottery Neolithic B period. The floor structure is similar to the plaster found at other PPNB sites in Israel, but the materials and technology were adapted to the local dolomite rich geology.

Identifying properties of ancient lime mortars in the Roman baths of Tyre, Lebanon

Ali Khalil Badawi ⁽¹⁾, Aurelia Badde ⁽²⁾ André Gardei ⁽³⁾, Linda Hakim ⁽¹⁾, Bernhard Illerhaus⁽³⁾, Dietmar Meinel, Engin ⁽³⁾

(1) Directorate General of Antiquities, Tyre; Lebanese University, Branch 5, Lebanon

(2) M.A., conservator in private practice, Berlin, Germany

(3) André Gardei, Dipl.-Geol., Federal Institute for Materials Research and Testing (BAM), Berlin, Germany

Abstract

The baths, as a civil institution, are representative of the civic prosperity of the city of Tyre over periods of dramatic changes. Our on-site observations, material investigations and scientific analyses focus on the fine details of material composition, context and coherence, and contribute new data to the study of ancient mortars and to the archaeology of this site.

The varied marble paving patterns in the central basin of the frigidarium manifest material evidence of destruction and relaying. To match these renovations, material analyses were conducted on samples from the marble paving's substrate. The material composition of sampled mortars was identified with microscopic and thin-section analyses, 3D X-ray micro-computed tomography (3D- μ CT), Fourier transform infrared spectroscopy (FTIR), micro X-ray fluorescence (μ -XRF), X-ray powder diffraction (XRD) and radiocarbon (^{14}C) dating. Our investigations also comprehend the bedding mortars underlying the extant opus sectile in the four adjoining side-rooms. These data can be drawn on to found reliable hypotheses about the relative relationships between the various visible stages of renovation in this complex site.

Geoarchaeology of prehistoric Cypriot architecture. Integrated analyses of mudbricks from Middle Bronze Age Erimi

Marialucia Amadio⁽¹⁾, Luca Bombardieri⁽²⁾

(1) *Dipartimento di Civiltà e Forme del Sapere. Università di Pisa, Italy*

(2) *Dipartimento DFCLAM - Università di Siena, Italy*

Abstract

Among the building materials, mudbricks constitute an integral part of architectural constructions and possess more than just structural information and environmental data; they represent optimal indicators to identify the production choices as means for social representation and communication. Results obtained from the multi-proxy analysis of mudbrick materials recovered and sampled at the Middle Bronze Age site of Erimi-Laonin tou Porakou (c. 1950-1650 BC) are presented in this paper as pilot geoarchaeological examination of prehistoric earthen architecture in Cyprus. Mudbricks were preliminary examined in the field and further analysed by integrated high-resolution micromorphological, spectroscopic and geochemical analyses with the aim of generating new interdisciplinary data to study aspects of procurement strategies, labour organisation and level of technological specialisation at Erimi (Amadio 2018; Bombardieri 2017; Ingold 2000; Lemonnier 1993; Love 2013; Matthews *et al.* 2013). Results indicate that materials were sourced locally according to their easy accessibility, however the expert selection of sediments and tempers in the mixtures points towards an organised craft production. The identification of proper recipes in mudbricks and the consistency in shape and size observed in the intact materials recovered at the site suggest the existence of cooperative forms of labour and specialised work, which appear to be distinctive aspects of the transformative social environment of Middle Bronze Age Cyprus.

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An application of point pattern analysis and spatial statistics in lithic distributions

Anastasia Eleftheriadou

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Abstract

The camp of Ouriakos (Lemnos, Greece) is an Epipalaeolithic open-air site with a remarkable density and quantity of lithic findings which denote the specialized production of a specific microlithic tool (lunates) (Efstratiou et al 2013). Main goal of the study is to examine (a) if quantitative spatial analysis can efficiently untangle its complex archaeological record, (b) to what extent can spatial statistics encounter possible biases and (c) how can spatial analysis help us infer human behavior. The methodology used is point pattern analysis, namely, a set of statistical methods which explore potentially complex spatial relationships of real-world phenomena (Bevan 2020). The parameters affecting the data's distribution were distinguished between first and second order effects, depending on the absence or presence of human involvement respectively. The impact of the former was quantified and evaluated using Akaike Information Criterion and logistic regression analysis, while the later was explored by using Ripley's K function, Bivariate K function, Pair Correlation Function and Kernel Density Estimation.

Based on ethnographic and experimental studies, we extrapolated the potential spatial patterns associated with knapping activity. Despite the limitations of data availability and patterns' recovery level, we identified one primary and two secondary deposits. The knapper working at that area was most probably seated, while the observed patterns conform to the type of raw material used and the knapping method proposed by Efstratiou *et al.* 2014. The distribution of burnt lithics didn't reveal any hearths but indicated their presence nearby. Finally, three biases were identified, related to the tendency of particular tool types to be underrepresented, the effect of deflation and human errors. To conclude, point pattern analysis comprises an effective heuristic tool not only for the study of complex archaeological records and therefore human behavior, but also for the control of potential biases in our workflow.

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Island metallurgy: Investigation of Cypriot metal objects in the collection of The Fitzwilliam Museum, Cambridge

Susanna Pancaldo⁽¹⁾, Jana Mokrisova⁽¹⁾ and Ema Bauzyte⁽¹⁾

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Abstract

A core aspect of The Fitzwilliam Museum's 5-year 'Being an Islander' research project is to critically re-examine concepts of island life through the investigation of materials, methods of production and use of objects of ancient cultural heritage from three large Mediterranean islands: Cyprus, Crete, and Sardinia (<https://islander.fitzmuseum.cam.ac.uk/>). This contribution presents some of the results of a research initiative focused on the study of metallurgy from these islands, in particular from Cyprus. The Fitzwilliam Museum holds a collection of over 180 Cypriot metal objects. Chronologically, these span from the Early Bronze Age to the Roman period. Worked from various materials (primarily copper-alloy, iron, gold, silver and lead) and of various types (weapons, tools, vessels, symbolic and cultic objects, jewellery), most were bequeathed to the Museum in late 19th and early 20th centuries and excavated from Leondari Vounou, Vounous, Tamassos, Marion and Paphos. Given the broad time-frame, wide range of types and dissimilar excavation and post-excavation histories, we focussed our research goals not on typological or provenance studies, but on investigation of the materials, methods of production and the use of the objects in ancient contexts. An initial survey was undertaken to evaluate the conditions of individual objects and their potentials for revealing aspects of their 'life-cycles' through scientific research. A selection of 30 artefacts was then chosen for in-depth study, and a variety of investigative methods were employed, namely macro- and microscopic examination, X-ray computed tomography, XRF, micro-CT and SEM-EDS analysis. Reconstruction of the *chaine operative* for each of object reflected upon larger themes explored in the 'Being an Islander' project. A key of study was of an exceptional Cypriot Archaic-period sword (GR.334.1892). This and other case studies show that, despite transformations in materials due to archaeological burial and over a century of existence above ground, technical investigation can fundamentally contribute to an understanding of cultural identity.

Assessing the Iron-Working Skills at Roman Judaea: An Archaeometallurgical Study of Two Bar-Kokhba Revolt Assemblages from Israel

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Abstract

On the surface, the topic of Roman iron technology has been extensively researched, both of production sites and artifacts (i.e. Lang, 2017). However, a closer examination shows that this statement is far less accurate for to the Eastern Roman provinces. Specifically, for the Roman Province of *Judaea*, located within the modern borders of Israel, this is exceptionally true. Despite a growing interest in ferrous metallurgy of earlier periods (Eliyahu-Behar and Yahalom-Mack 2018; Erb-Satullo 2019), the classical periods have lagged behind. Literary sources suggest that the region had a rich history of iron production (see Dio Cassius 69.12.2), but one would be oblivious to this if they browsed through the academic record. A brief study by Knox, Maddin and Muhly (1983) examined artifacts used by Jewish rebels at Masada dated to the 1st century AD.

This study examines the ferrous assemblage from two Jewish villages, Horvat Tsalit and the Nahal Yattir Site, dated to the 1st-2nd centuries AD and violently destroyed in the Bar-Kokhba rebellion of 132-135 AD. This both gives us a strong chronological anchor and a rich assemblage of both weapons, tools and day-to-day objects. The artifacts were studied typologically, and twelve objects representing various functions were selected for examination using optical and electron microscopy. Uniquely combining both macro and microscopic methods to objects of contrasting nature, we aim to provide a comprehensive investigation into the types of ferrous alloys in use, smithing techniques and skill.

Preliminary results show that despite all objects being heavily corroded, the common alloy in use was hypoeutectoid steel, both for weapons and daily objects. In blades of tools and weapons, it appears in banded structures. Some weapons and tools were hardened by cold-working and possible annealing. Any evidence for quenching and or carburization is masked by the corrosion.

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Osmium isotope analysis as an innovative tool for provenancing ancient iron: Application for sourcing Iron Age objects in the southern Levant

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Abstract

Recent research has yielded new and pertinent data concerning the introduction of iron technology into the southern Levant, towards the end of the second and the beginning of the first millennium BCE. However, despite major research advancements, provenance - a key question regarding the invention, adoption, and spread of iron technology - remained unanswered. Through a series of iron smelting experiments, using iron-ore deposits from the Negev region, (modern) Israel, we showed that provenancing based on Os isotope analysis is a powerful tool for correlating ancient ferrous metals to their ore source. The successful smelting experiments resulted in the formation of well-consolidated iron blooms that were subsequently forged into bars. Analysis of the Os isotopic composition of the ores, blooms and metal bars confirmed that the $^{187}\text{Os}/^{188}\text{Os}$ isotopic ratio is maintained from ore to metal, with no significant isotopic fractionation, and that enrichment/depletion of Os content occurred between ore to metal and ore to slag. Moreover, we showed that the ores from the Negev are well suited for the bloomery process, and that different geological ore deposits exhibit variability in their Os ratio. The current lecture reveals the initial results of the application of the method to provenancing iron objects from Iron Age contexts within the southern Levant. The results are plotted against analyzed ore sources from the region and the potential of the method is discussed.

Collagen extraction and evaluation of organic preservation in skeletal material from the Neolithic settlement in Dispilio, Greece

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Abstract

Research during the last decades has shown positive results regarding the preservation and extractability of organic molecules in both archeological and paleontological skeletal material (Schweitzer *et al.* 2007). Studies on such molecules via extraction and/or isotopic and IR analyses (Stathopoulou *et al.* 2008; Stathopoulou *et al.* 2019) can provide useful information in evolutionary, environmental and diagenetic studies. Collagen is one of the most abundant proteins in bones and its presence in fossils can be indicative of the preservation of other more complex biomolecules such as DNA.

The objective of this paper is the extraction and quantification of collagen and the evaluation of organic preservation in fish and mammal bone samples from the Neolithic settlement in Dispilio, Greece which has been dated back to 5500 – 3500 BCE. The methods used for the extraction of collagen are modifications of the Longin method according to Maspero *et al.* (2011), Semal and Orban (1995) and Ambrose (1990). Infrared Spectroscopy (ATR and NIR) was also applied to all samples, prior and following extraction, in order to examine the correlation between collagen preservation and the samples' diagenetic profile (Stathopoulou *et al.* 2008; Stathopoulou *et al.* 2019) but also to study the exact composition of the extracts.

After attempting different protocols, we established that only the Ambrose method led to successful collagen extraction. The collagen yield values varied significantly (0,3 - 6,1 % w/w), strongly correlating to context variations within the archeological site. The IR analysis of the extracted Dispilio collagen indicated the presence of impurities such as carbonates and oxides and subsequently raised questions relating to the efficacy of the extraction method.

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Before they were Kings: An interdisciplinary study of consumption practices in the Ayios Vasileios north cemetery (Laconia)

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Abstract

The Early Mycenaean cemetery of Ayios Vasileios in Laconia offers unique insights into mortuary practices at the dawn of the Late Bronze Age (ca. 1700-1500BCE). The North Cemetery consists mostly of large and carefully constructed cist tombs, but the majority of burials was unfurnished. Although a number of studies are engaged in the investigation of this formative period, integrated approaches emphasising on the social practice of consumption and contextualised understanding of material culture are still scarce.

In this paper, we present the results of an interdisciplinary study of ceramic use and human bones in early Late Helladic interments. We integrate organic residue analysis in ceramic vessels using gas chromatography coupled with mass spectrometry (GC-MS), isotope analyses on the skeletons, and a detailed typological characterisation of the pottery recovered from the tombs, to explore the ways technological, ecological, and social factors affect consumption in the mortuary sphere.

Isotope analyses on bones indicate the exploitation of a wide area for cultivation and food provenance, implying a relatively mobile population. Ceramic offerings are few in number and consist only of one or two small vases per burial, usually a drinking cup and a small jar, but a variety in style and fabric suggests increased interaction with areas further afield. Organic residue analyses show that several of the vessels in the graves had been used before deposition and contained lipids from animal sources and plant oils.

This holistic study of both pottery and skeletal remains from the North Cemetery will offer new perspectives for approaching social practices in Early Mycenaean Laconia.

Archaeobotanical perspectives from two thousand years at Tell es-Safi/ Gath

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Abstract

Archaeology deals with reconstruction of ancient way of life, unravelling past societies' idiosyncrasy and interconnections in land-use modes, economy, trade, and culture. Tell es-Şāfi/Gath is a large and multi-period site revealed four consecutive periods of the southern Levant: Early Bronze Age, Late Bronze Age, Iron Age I, and Iron Age II, i.e. from the middle of the third millennia BCE to the 8th century BCE. This situation allowed a rare opportunity for a comparative analysis of ancient diet and environment during the period of two thousand years.

Here, we present an overview of the vegetal diet and land use at Tell es- Safi/Gath throughout these periods and cultures such as Canaanites, Philistines, and Judahites. We address the vegetal part of their diets, combining Tell es-Safi/ Gath results with data from nearby sites. This data enables a quantitative and qualitative analysis of local diet, the main intrinsic components of local diet and land-use, and intra- and interregional food connections. These results of the study shed new light on the steps and patterns of integration within East Mediterranean trade, and mirror southern Levant idiosyncrasy within the contemporaneous Mediterranean crop basket.

Study and investigations of archaeobotanical remains from Tutankhamun tomb

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Abstract

An immense “natural” treasure was recently recovered from the storerooms of the Archaeological Museum of Cairo. Once moved to the new seat and museum, the Grand Egyptian Museum, it was time to start studying this precious “rubbish” recovered one century ago, at the end of the archaeological excavation of the tomb of Pharaoh Tutankhamun by Howard Carter’s team. The study focuses on carpological remains swiped from the surfaces of the tomb and deposited in a wooden box in 1933. The carpological remains retrieved from the box are still in excellent condition, and allowed identification at a species level. Identified remains contained fruits and seeds belonging to 24 species belonging to 14 different plant families. New Species found in all the tombs of the Eighteenth Dynasty include faba bean (*Vicia faba* L.) and onion (*Allium cepa* L.). Egyptian luffa / sponge gourd (*Luffa aegyptiaca* Mill.) is a total novelty.

In this work I started analyzing the plant remains, using only a qualitative approach. The restrictions caused by the pandemic prevented, in fact, a continuous laboratory work and the complete identification of the so far extracted macroremains.

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Variations of the Geomagnetic field during the second and first millennia BCE through the study of Greek pottery: Impact for archaeology

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Abstract

The magnetic field which surrounds the Earth (GMF) acts as a “natural shield” and protects life from harmful cosmic radiations. Its study started in the 16th century AD and reached an ongoing outburst during the 20th and 21st centuries. This period of historical observations is too short to account for the long history of the Earth. The property of natural rocks containing iron oxides to record the GMF at the time of their formation allowed the recovery of long records through geological periods. A similar procedure was reported within the natural clays when they were fired and cooled. Consequently, all archaeological items originating from burnt clays (kilns, pottery, hearths) can act as natural recorders of the GMF. This discipline (archaeomagnetism) led to a massive dataset which allowed to build reference or secular variation curves, from local to regional and global scales. An important part of this dataset is centered to Europe and the Middle East, and these regional curves displayed a number of non-regular oscillations of the GMF with extreme values particularly well monitored in the Middle East and W. Europe, for the Bronze age (Brown *et al.* 2021). In Greece very few such data existed until recently, when the combined efforts of two laboratories allowed the study of ceramics and baked clays dated in the third and second millennia BCE. The outcome of these studies (Kondopoulou *et al.* 2017; Rivero-Montero *et al.* 2021), together with new unpublished data (Aidona *et al.*, to be submitted) provided important information on the GMF intensity variations as well as the suitability of the studied clays in relation to the geological environment. When plotted within the regional curves for the Eastern Mediterranean, our results fill several gaps and contribute to an eventual impact of the GMF variations to the archaeological record for this period.

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Minor marble objects and trade networks: The case study of Meter reliefs from Ephesos

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Abstract

The Sanctuary of Meter, on the north slope of the Panayırdağ in Ephesos has revealed a large number of Meter reliefs which were originally placed in small niches cut into the marble/limestone bedrock of the Panayırdağ. The dating of the objects is i.e. late classical-early hellenistic 4/3 c. BC. The marble provenance analysis of a group of these reliefs, now located in the Museum of Selçuk in Turkey proves that the marble of these objects originates from different Ephesian quarries. The application of various methods such as stable isotope analysis (C13 and O18), multi - element trace element analysis by ICP-MS, in combination with petrography showed the provenance of these artefacts and unwraps the workshop for the production of these votive plates in Ephesos in Asia Minor. A further investigation on the Meter Relief I 1108 from the Art History Museum in Vienna showed that this marble also originates from the Ephesos II quarries (Ladstätter *et al.* 2019). Further recent investigations on Meter reliefs from different regions, now in the Art History Museum in Vienna, showed the use of other provenance sources such as Prokonnesian and Pentelic marbles.

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Is there something missing in provenance studies of ancient marble?

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*Dept. of Archaeology, Yarmouk University, Postal code 21163, Irbid Jordan***Abstract**

Determination of the provenance of marble artifacts by means of archaeometric analyses has a long and distinguished history in archaeology and relevant disciplines. Marble databases were continuously updated in the past decades and new marble sources (quarries) were uncovered. Multiple approaches including, among others, mineral, petrographic, isotopic, chemical analyses was successfully used in the determination of marble sources. However, marble provenance investigations of several cases were not successful and the sources of the marbles remained unknown indicating that there is there something missing in scientific provenance studies of ancient marble. The presentation will discuss some case studies of unsuccessful provenance determination of imported marble uncovered from archaeological sites in Jordan, and then will discuss the probable missing data that caused the unsuccessful results.

Blue my mind: The discovery and experimental production of Persian Blue

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Abstract

Blue is the rarest colour in nature. The first synthetic pigment is blue (made in Ancient Egypt 3250 BC). Egyptian Blue is the only known ancient recipe for production of inorganic blue pigment, yet the earliest written evidence of Egyptian Blue recipe is that of Vitruvius (1st century BC). The modern scholarly synthesis of Egyptian Blue goes back to the late 19th century CE. Current literature therefore is mainly focused on Egyptian Blue and other natural blue pigments, while the Persian accounts of production of “fake lazuli” have never been investigated until the results of this research into a cluster of historical Persian manuscripts known as “The Book of Jewels” or “*Jawahir-Nama*” with practical information on the production of fake gemstones, including Lapis Lazuli. We identified various copies as early as the 12th CE.

In this presentation, we provide an overview of technical interpretation of recipes of “making fake lazuli” from a couple of Persian manuscripts dated to 12th and 13th century CE, in addition to a step by step account of the experimental reproduction of what we call Persian Blue. The purpose of the experimental work was to understand whether the recipes indicate a different blue pigment synthesis in comparison to Egyptian Blue. The experiments resulted in a blue product that was visually and compositionally analysed with Reflected Light Microscope and SEM-EDS and led to the discovery of a blue pigment with chemically and visually distinct crystal characteristics. Another significant finding was the unstable nature of the by-product of this process, which if not eliminated, is extremely reactive to the environment and detrimental to the blue crystals.

This research opens up a new line of investigation in the identification of Persian Blue in various contexts, in addition to the potential characterization of decolourised pigments that used to be blue.

Fragments of luxury: Glass findings from the Palace of Mystras

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Abstract

A large assemblage of glass findings from the Palace of Mystras, Lakonia, Greece, was analysed via SEM/EDS and Raman spectroscopy, aiming to determine their raw materials, manufacturing technology and likely provenance. Overall, 140 fragments of everyday use objects of exceptional quality (glasses, bottles, lamps, etc) were analysed. The fragments vary significantly in colour and transparency and they often present complex decorative patterns; the majority shows strong corrosion effects. Their date cannot be determined with specificity but has to span between the mid 13th and mid 19th c. AD, the period since the construction of the site and throughout its continuous use as the administrative centre of the Despotate of Mystras.

Based on the chemical and mineralogical analysis a complex image emerges, suggesting the use of varied raw materials (Na- or K-rich plant ash, potash, saltpetre as the alkali source; manganese and arsenic as decolourants; tin and antimony as opacifiers). Given that during this period there was a high diversity in the manufacturing technologies used in glass workshops from different areas, it is possible to identify glasses originating from both the eastern regions of the Ottoman Empire (following the Islamic tradition of glass making) and from Europe (e.g. Venetian cristallo, Bohemian crystal, forest glass from central Europe etc.).

The site of Mystras presents immense significance as an administrative, commercial and art centre of the late Byzantine and post-Byzantine period. Glass analyses for this period are extremely limited throughout the Balkans, while the present project is the first analysis of glass from the extended area of Lakonia. Taking also into consideration the well-documented successive construction phases of the various buildings of the Palace, as well as the available information on the use of each building, it is possible to provide with significant insights into the commercial, artistic and technological interactions of Mystras with the Ottoman Empire and Europe.

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Archaeological Science studies in the EMME region

Session chairs: Prof. Apostolos Sarris, Prof. Yorgos Facorellis

Poster presentations

A bridge between Science and Archaeology in studying Tutankhamun's collection

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Abstract

This proposal will outline a multi-disciplinary project to enable to study, investigate and analysis the contents of a wooden box filled with remains that were swept from Tutankhamun tomb by Howard Carter and his team. The research focus on the materials recovered from the tomb of the pharaoh Tutankhamun of the 18th Dynasty. The object of the project will be various material such as organic remains, clay sealed, resin, painted layer, golden pieces, beads, ivory, bones remains, currently stored in the newly constructed Grand Egyptian Museum in Giza (Egypt). The project intends to allow reconstructing, for the first time, a complete image of funerary practices in Ancient Egypt– by the generation of new data, images and information concerning the re-discovery of Tutankhamun tomb, ultimately facilitating publication of the results of these important materials.

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Contextualizing and interpreting biological distance from dental metric data at Oymaağaç, Turkey (1st c. BCE-2nd c. CE)

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Abstract

Genetic associations and measures of biological relatedness provide integral dimensions to understanding both construction of mortuary landscapes and demographic profiles of cemetery populations. At the archaeological site of Oymaağaç Höyük, multiple interment graves from Hellenistic-to-Roman times reflect a sustained tradition of communal burial by the rural populace, but the composition of these grave groups (e.g., family) currently remains speculative with no discrete historical or artifactual evidence. While previous examination of heritable non-metric accessory ossicles suggests biological relatedness across the cemetery and between graves (Green and Marklein, 2021), these variables are limited by preservation and recovery. To better understand potential familial and communal practices of burial, biological distance analysis on permanent dentition was conducted. Metric (mesiodistal, MD; buccolingual, BL) data were recorded from 766 left (right when missing) teeth in 49 female and 100 adult males among 11 grave contexts. Due to the commingled state of several graves, preservation, and dental attrition, MD and BL measurements could not be taken for all observed teeth, and some individuals were associated with only a few dental measurements. Consequently, univariate (nonparametric Kruskal-Wallis) and exploratory (Principle Component Analysis) analyses were employed. Among the 31 compared measurements, Kruskal-Wallis tests indicated significant ($p < 0.05$) and approaching significant ($p < 0.10$) differences in MD and BL measurements between grave contexts among 14 and 3 metrics, respectively, with post-hoc tests demonstrating consistently smaller dental metrics among grave 7484.21. On an individual level, PCA showed similar spatial disparities in males between grave 7484.21 and other grave contexts. Morphoscopic dental and ancient DNA evidence offer future directions for teasing apart mortuary nuances at Oymaağaç. Preliminary intracemetery biodistance results are the first evidence of these particular interment practices in the Pontus region and attest to burial decisions predicated on both closely-related and less biologically-related groups.

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An updated chronology of Tepe Sialk in Iran, based on OSL and C14 dating

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Abstract

Tepe Sialk of Kashan located in the central Iranian Plateau, is considered as one of the five most important archaeological sites in Iran. It consists of two prominent mounds 500 meters apart: Sialk North and Sialk South with cultural layers spanning from the beginning of the sixth millennium BCE until the later prehistory (Fazeli Nashli *et al.* 2013, Pollard *et al.* 2013). The most prominent mound is Sialk South (Fig. 1) crowned by a massive, ziggurat-like, mudbrick platform.

A number of ¹⁴C ages generated for both sites (Pollard *et al.* 2013) under a new investigation project in 2009 run by Prof. Hassan Fazeli Nashli from the University of Tehran, indicate that the beginning of occupation at Tepe Sialk took place before 5841-5679 cal BCE but not earlier than the beginning of the 6th Mill. BCE. The radiocarbon dates revised previous ideas about the chronology of the site proposed by the first excavators in 1930's who dated Tepe Sialk to the Chalcolithic-Early Bronze Age period. Additionally, the existence of layers related to the proto-Elamite period right underneath the mudbrick platform at Sialk South attracts great interest, as the proto-Elamite period is essential not only because it bears the earliest evidence for a writing system but also because it is a widespread cultural phase across Iran.

Given the fact that Sialk South lacks the plentiful of ages formerly generated for Sialk North and charred material suitable for ¹⁴C dating from archaeological layers is less frequent, the application of optically stimulated luminescence (OSL) dating was considered necessary. This project generated a chronological framework for the construction of Sialk South and the underlying proto-Elamite archaeological layers by dating through OSL mudbricks from the platform and sediments from the underlying layers respectively.

We took seven samples of mud bricks and loose sediments underneath the mudbrick platform at Sialk South for OSL dating. Our results ranged from the Late Chalcolithic period to Proto-Elamite and Elamite period, giving evidence for the use of the Sialk South since then. Our findings agree with the archaeological record, highlighting Tepe Sialk as a key-location in deciphering the chronology of the advancement of the Elamite civilization towards the rest of Iran.



Fig.1 Sampling site of Sialk South

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Archaeobotany in Tinos Island: A preliminary test of applicability

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Abstract

During a rescue excavation from 2018 to 2019 in Lakkos in the area of Kionia in Tinos Island, an agricultural establishment of the Late Classical to Roman Period was found. It is the first discovery of a building dedicated to agricultural production on the island. The excavators found evidence of olive oil production and apiculture, as well as possible evidence for viticulture. To gain a better understanding of all the processes around olive oil production, soil samples were taken for archaeobotanical investigations. Already during the excavation, a perfectly preserved leaf of an olive tree (*Olea europaea* ssp. *europaea* L.) was found in a subfossil (desiccated) state. Therefore, 7 soil samples with a total volume of 450 ml were taken and analyzed. The sampled sediment consisted of hard concretions of sandy-clayey soil, which was carefully wet sieved. The examination resulted in a few organic finds including charcoal and seeds, both desiccated and charred. The remains are too few to draw detailed conclusions, yet they confirm agricultural activity at the site. This result shows the importance of systematic archaeobotanical investigations, which have great potential in supporting archaeological theories.

Plaster, cartonnage, and the making of Egyptian coffins: Project overview

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Abstract

Whether obtained from lime, gypsum, limestone or mud (Lucas 1924), plasters are among the most abundant materials in the archaeological record, but also severely understudied. Often considered only as “sacrificial layers” or functional materials, researchers have paid comparatively little attention to their composition and technology, and how these may inform about broader sociocultural phenomena. The absence of research is even more startling for plaster or plaster-like materials used in the making of artefacts rather than as building materials.

This poster presents a new project that seeks to contribute to fill this gap by focusing on plaster, cartonnage and other lime-based pastes used to make coffins in Ancient Egypt. Most of the studied materials will come from the Egyptian collections at the Fitzwilliam Museum, where important background work has already been carried out (Dawson 2016S; trudwick and Dawson 2016), but other collaborations will be explored. Our main goal will consist of building a timeline of the materials and techniques used for the production of plasters from the Old Kingdom to the last Roman Period, also paying consideration to variability across space and between contexts.

Giving the heritage status of these artefacts, the analytical work will employ mostly non-destructive and non-invasive techniques, such as μ CT, optical and electron microscopy, XRF, and Raman. In addition, and in contrast with most of previous work, we will seek to characterise organic materials included in these pastes, including fibers and glues.

This work will provide new information about this neglected material, in addition to offering an insight into the technical ability and choices made at workshops at the time. Ultimately, we hope to define different artistic traditions, possibly associated to various city centers (such as Thebes, Memphis, Fayum and Abydos), or to different use contexts, as well as variations that may result from fluctuations in political stability and economic networks.

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Thouria Lagynos: An organic residue study

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Abstract

A lagynos vessel from the Ancient Thouria archaeological site was found undamaged during a rescue excavation. Based on the vessel type and appearance, it was assumed to have contained wine or oils which were used in a funerary context (Oakley 2004). As the vessel was discovered in a rescue excavation, it is important to understand the state of the vessel in addition to its contents. In order to verify the identity of the vessel's organic residue, archaeometric analysis was required. Due to the delicate and unique state of the lagynos, the archaeological soil inside of the vessel was analysed in order to prevent damage to the vessel itself. The study was conducted through the use of minimally invasive artifact microscopy, SEM-EDS methodologies, RAMAN spectroscopy, and FTIR spectroscopy. In order to evaluate the results, the archaeological soil was compared against reference soils collected from the Thouria area. Based on the results of the analysis, it is assumed that the organic material remains from inside of the vessel can be attributed to wine and that the vessel was unmoved post-deposition in the tomb until its rediscovery in 2018.

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XRF Analysis of 16 Hellenistic coins: An archaeometric approach to bronze alloys of Ancient Messene coinage

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Abstract

The present research seeks to explore how an analytical study of Roman bronze coins from Ancient Messene can shed light into the economy of this area (Themelis 2014). Sixteen bronze coins, which date from the 2nd B.C. until the 1st A.D. century, recovered during the systematic excavations conducted by P. Themelis and were typologically studied by K.I. Sidiropoulos (1996). The study focused on their elemental composition for the determination of the metal alloys used. A secondary aim of the study was to determine the lingering effects of corrosion and passed conservation treatments.

The methodology included a microscopic and analytical approach. Initially, the samples were examined by a LED microscope (I-Scope Moritex), and then chemically analysed with by portable X-Ray Fluorescence (Bruker Tracer III SD) (Liritzis and Zacharias 2011). Both methods are non-invasive and were conducted in-situ.

Subsequently, 3 groups of coins resulted from the data analysis (Fig. 1): (1) The first group includes the highly corroded samples (Cu>62%, Sn > 21%), as was observed by the microscopic analysis as well. (2) The second group includes 8 of the samples (Cu: 72.59%-76.18% and Sn: 17.20% - 21.21%). They make up the majority of the sample range. (3) The third group includes the 2 coins of one specific mint superintendent, NIKAPXOC (Cu ≈ 81-84%, Sn ≈ 10%).

It was concluded that damage from corrosion effects and previous conservation attempts was evident to a lesser or higher degree on all coins. However, from the analysis of the cleaned surfaces it appeared that the samples have a high tin bronze alloy, which agrees with the historical context. Most of the mint superintends fall into one principal sample group, which dates from the 2nd B.C. until the 1st A.D. cent. It shows Messene's stable coin production in the passage of time; only master NIKAPXOC has a distinctly different alloy.

For more comprehensive results, a larger assemblage is required.

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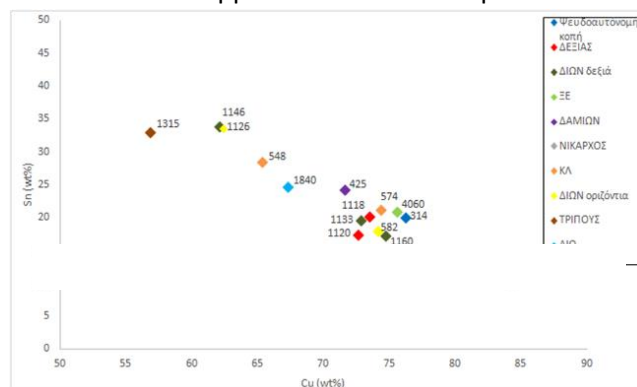


Figure 1: Cluster plot of Sn (%wt) versus Cu (%wt).

**Mediterranean palaeomobility:
written sources, material networks and skeletal data**

Session chairs: Dr Efthymia Nikita and Prof. Cyprian Broodbank

Oral presentations

Hala Sultan Tekke, Cyprus: Interregional interactions in the Late Bronze Age

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Abstract

The Late Bronze Age societies in the Mediterranean and beyond established effective trade networks in the 2nd half of the 2nd Millennium BC. The material from 12 seasons of excavations in the harbour city of Hala Sultan Tekke and the city's extra-urban cemetery demonstrated far-reaching intercultural connections (Fischer 2019a, b; Fischer and Bürge 2017; 2018; 2020). The heydays of these interactions fall into the period 15th/14th–13th centuries BC (Late Cypriot IIA-C). In this period, copper was produced on a large-scale in intra-urban workshops of the city which could be demonstrated by finds of furnaces and tons of copper slag and ore. In addition, there is evidence for the production of purple-dyed textiles. Both products were in excess of local needs and surplus became the basis for the acquisition of coveted goods. These merchandises, together with the city's favourable position in the central part of the eastern Mediterranean and one of the island's best sheltered harbours, transferred the city into an important trade hub where imports from a vast geographical area can be demonstrated. The acquired data provide a convenient base to investigate the preconditions and effects of interregional trade. In addition, this presentation aims to offer explanations on the organisation of trade, and to define the geographical scope of trade. Hypotheses will be presented as regards direct trade with various cultures versus the acquisition of goods via middlemen.

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Isotopic assessment of the diverse burial sample from Late Helladic and Protogeometric Mitrou and Tragana-Agia Triada

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Abstract

The use of paleodiet and paleomobility evidence in bioarchaeological studies across the eastern Mediterranean have proliferated in recent years because of the recognition of their importance for understanding human burial samples and as laboratory costs associated with such studies have declined. This research focuses on the assessment of $\delta^{13}\text{C}$, $\delta^{18}\text{O}$, and $^{87}\text{Sr}/^{86}\text{Sr}$ data from human and faunal dental samples from various burial and excavation contexts at the sites of Mitrou and Tragana-Agia Triada in Central Greece. Associated time periods for these samples include the Late Helladic and Protogeometric periods, thus providing insight into potential migration and mobility patterns during the transition from the Bronze Age into the Early Iron Age on the west coast of the North Euboean Gulf. The analysed sample consists of 34 human dental samples (25 from Mitrou and 9 from Tragana-Agia Triada) and five faunal samples (all from Mitrou). The human $^{87}\text{Sr}/^{86}\text{Sr}$ values are from a subset of this sample (10 human and 5 faunal) and fall mostly within the $^{87}\text{Sr}/^{86}\text{Sr}$ range of the local faunal samples. In addition, these values compare well to recent regional baseline research of bioavailable $^{87}\text{Sr}/^{86}\text{Sr}$ across eastern central Greece (Frank *et al.* 2021). In addition, three samples relate specifically to Tomb 73 from Mitrou, a monumental built chamber tomb, which has been the focus of recent research on the ceramic assemblage and tomb architecture and placement in relation to the site layout and planning (see Van de Moortel 2016 and Van de Moortel *et al.* 2019). Isotopic data from dental samples from Tomb 73 will be discussed in relation to the other Late Helladic isotopic samples from Mitrou and Tragana-Agia Triada, the Protogeometric samples from Mitrou, and recent isotopic data from central Greece.

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Diet and population admixture at *Colonia Iulia Augusta Diensis* (Dion)

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Abstract

Located at the foot of Mount Olympus, Dion was the Macedonians' religious center and federal shrine from the 5th c. BC onward. In 169 BC the city fell to the Romans, and in 32/31 BC Dion became a Roman colony and flourished until the end of the 3rd century AD. Dion was a highly connected urban centre and part of the network of colonies established in the Greek Peninsula by the Romans. Epigraphic texts and coinage bear witness to a bilingual population and a community that gradually evolved in a process of interaction and exchange leading to the fusion of the Roman and Greek cultures, a multi-ethnic population and a complex society. Our investigation aims at evaluating the degree of fusion between the Greek and Roman culture at the colony of Dion through the lense of bioarchaeology. Within this frame, we present here preliminary results on stable isotope and biodistance analysis collected from the Roman burials (1st-3rd centuries) unearthed at the North and West necropolis of the city. We test the question whether individuals buried in these two distinct archaeological groupings represent different biological and/or sociocultural units; to reach this aim, we compare the diet ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) and biodistance of individuals buried in the two necropoleis. Results offer new insights into the genetic, social and cultural makeup of Roman colonies in Greece and underline the importance of interdisciplinarity in the analysis of cultural contact of past populations.

Mobility and connectivity in Early Roman Crete: The evidence from the tombs and the scope for further skeletal investigation

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Abstract

This paper considers the impact of mobility and increased connectivity on human health on Crete in the Early Roman period and considers what further analyses can give better insight into the levels of migration to different centres on Crete at this time. I consider how the changing socio-economic climate on Crete impacted on human health, diet and wellbeing. In the early Roman period, there were some major changes on the island as it was incorporated into the Roman Empire in the form of increased connectivity within Mediterranean networks. Newfound peace and stability allowed Crete to become a more active participant in trade networks, particularly in the export of wine. The social impact of increased mobility and connectivity is seen in the dramatic diversification and monumentalisation of tomb forms in the 1st century AD, with Roman, Alexandrian, Cypriot and Asia Minor connections evident in the tomb types. At Knossos, which became a Roman colony in 27 BC, there were some subtle differences in health status between the Hellenistic and Roman periods detected from the investigation of age at death, dental diseases, joint diseases, enthesal changes, and bone lengths. However, the question remains as to whether there were significant numbers of newcomers at the site, with little in the archaeological record to attest definitively to such a presence and only one tomb (an impressive built tomb or free-standing mausoleum, with an underground chamber) that has a Latin inscription indicating that the deceased had a Roman name. I propose using strontium isotope analysis to further investigate the presence of newcomers at a variety of sites on Crete to consider the impacts of differential connectivity. However, I also consider the problems faced by inadequate sample sizes and consider how such problems might be circumvented and what problems this might cause for the interpretation of the scale of migration to different centres on Crete.

Mobility in Roman Phoenicia: A biodistance study

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Abstract

The geographic setting of the Lebanese coast in the Eastern Mediterranean and Middle East (EMME) prompted significant growth and development in the economic, political, and social structures of different Phoenician cities during the Roman period. This allowed the Phoenician coast to serve as a commercial hub with a prominent economy mainly focussed on activities such as: a) agriculture; b) artisanal production (e.g. textiles), c) Roman law school in Beirut. While biodistance studies in the EMME region have a long tradition, Lebanon represents a gap in most aspects of bioarchaeology with virtually no published biodistance analysis (Elias 2016, 2017; Nikita 2020). For this study, we use skeletal assemblages from Byblos, Beirut, and Tyre to obtain two types of phenotypic data (dental metric measurements and dental non-metric traits) widely used in biodistance studies as proxies for the underlying genotype, given their partly heritable character. We integrate the two data types in a single analysis and estimate biological affinities among Byblos, Beirut, and Tyre as well as within these assemblages using Gower distance coefficients. We also employ distance-based permutational multivariate analyses of variance (PERMANOVA) and dispersion (PERMDISP) analyses to statistically validate trends between and within the different coastal cities during the Roman period. This study seeks to evaluate the biological diversity of coastal cities of Roman Phoenicia and assess the effect of socio-political changes in biological relationships in a key region in the EMME.

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Stowaway: A Ship Rat's journey

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Abstract

The study of the maritime mobility of commensal rodents as a proxy for connectivity in the premodern Mediterranean has informed upon some of the earliest human movements around the basin, implicating ancient voyages that would have otherwise left an invisible wake on the surface of the Middle Sea. Documentation of rodent skeletal remains recovered from ancient shipwrecks is, however, extremely rare. The Ma'agan Mikhael B shipwreck (648–740 CE), an early Islamic period merchantman discovered on the Carmel coast of modern-day Israel, yielded the first and oldest direct evidence of a ship rat infestation on an antique sailing vessel in the premodern Mediterranean – including six complete *Rattus rattus* skulls. In an effort to ascertain segments of the ship's sailing route or possible trade partners, we conducted a geometric morphometric study to investigate potential regional variations in dental morphology. A comparative dataset of *R. rattus* specimens (N=169) from known geographic origins around the Mediterranean, including France, Spain, North Africa, and the Levant, as well as an 'outlier' group from the Northeastern Pacific, was gathered to test our hypothesis. The results of this study suggest that the ship rats onboard the Ma'agan Mikhael B reflected extra-regional morphological variability; this implies that interregional coastal trade continued within the dynamic conflict zone of Byzantine and Islamic naval forces during these turbulent times. The study of skeletal remains from this shipwreck has the potential to shed light not only on nonmilitary maritime traffic in the early Islamic period Eastern Mediterranean, but also informs upon late antique connectivity, trade, and exchange networks, as well as trajectories of disease, such as the Plague.

SrIsoMed: An open access database for Sr isotopes across the Mediterranean

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Abstract

SrIsoMed is a database containing over 12,000 $^{87}\text{Sr}/^{86}\text{Sr}$ measurements from organic and inorganic remains originating in countries across the Mediterranean. Strontium isotopes have been used extensively in archaeological sciences to explore the mobility of humans and animals as well as the provenance of material culture. Their utility is based on the principle that $^{87}\text{Sr}/^{86}\text{Sr}$ values differ geographically depending on the composition and age of the underlying bedrock in different regions as well as atmospheric surface and anthropogenic sources of Sr (e.g. rainfall, sea-spray, wind-transported dust, fertilizers). The materials sampled for the $^{87}\text{Sr}/^{86}\text{Sr}$ measurements included in SrIsoMed encompass human and animal bones/teeth, modern and ancient plants, water, as well as soil, sand and bedrock. The date and exact location of each sample (latitude and longitude) are also provided, along with the local lithology at the site of sampling. Therefore, these data may be used both for assessing the bioavailable $^{87}\text{Sr}/^{86}\text{Sr}$ baseline in different regions but also for generating $^{87}\text{Sr}/^{86}\text{Sr}$ isoscapes. SrIsoMed is aligned with other initiatives towards creating isotope databases for archaeological research, most notably IsoArch, a notable difference from the latter being that it is not restricted to organic remains but instead also encompasses geological samples. SrIsoMed is an open access database and its creation has been funded by the Research and Innovation Foundation in Cyprus through the People in Motion project, and H2020 through the Promised project.

Copper metallurgy in the EMME

Session chairs: Prof. Thilo Rehren, Dr Myrto Georgakopoulou and Prof. Vasiliki Kassianidou

Oral presentations

Copper alloys in the Early Bronze Age Aegean

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Abstract

Copper is by far the most versatile and commonly used metal of the Bronze Age. Alloying changes its properties, for example its colour, hardness, and workability and, with appropriate working, produces a metal superior for making functional tools, weapons, etc. In the Aegean, the Early Bronze Age is the period that sees extensive copper production using locally available resources (Bassiakos and Philaniotou 2007; Georgakopoulou *et al.* 2011), an activity that appears to largely cease in subsequent periods probably due to the exhaustion of the limited mineralisations in the region (Bassiakos and Tselios 2012). It is also the period when both main alloys in use throughout the Bronze Age appear or are extensively used for the first time; initially arsenical copper and soon after tin bronze. Arsenical copper was long considered an accidental alloy, made locally, intentionally or not, from mixed copper- arsenic minerals. Numerous strands of evidence are now challenging this assumption, suggesting deliberate mixing of materials, involving different pathways in the production of arsenical copper (Doonan *et al.* 2007; Georgakopoulou 2018). Tin bronze is known to be an exotic import in this region, whether as a ready-made alloy or at least in terms of the tin component. It makes a variable appearance in the Aegean, earlier in the third millennium BCE in the northeast (Pernicka *et al.* 1990) and later around the mid third millennium BCE in other areas (Stos-Gale *et al.* 1984), while its relative abundance compared to arsenical copper also varies between different sites and regions. How and when it starts being worked locally has not really been addressed. This paper brings together old and new evidence to consider aspects of the production and consumption of these alloys during the formative period of their use in the Aegean.

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Early zinc metallurgy in Urartu: Recent evidence from eastern Anatolia

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Abstract

During 2018 and 2019, salvage excavations were conducted in Murat Tepe and Murat Höyük, two mounds lie on the banks of the Murat River in the Solhan district of Bingöl Province in Eastern Anatolia. The metal finds unearthed in the Middle Iron Age/Urartu Kingdom layers provided remarkable data on the Urartian metallurgy. In this study, the results of archaeometallurgical analyses will be presented. Various finds from Murat Höyük and Murat Tepe were highlighted in particular, including twisted bracelet, ring and belt fragments. The results from portable XRF (pXRF), metallography, micro-hardness analyses, scanning electron microscopy, and energy dispersive X-ray spectrometry (SEM-EDS) showed that zinc was intentionally used as an alloy additive. In addition to the chemical composition of the belt, which consisted of zinc, tin, and copper, the ratio of copper to zinc detected in the bracelet and ring indicates that the metal used can be called brass. It is assumed that until the Roman period, zinc was not commonly used and produced in the Near East and the Mediterranean. Only a few Urartian finds are known that were made from zinc-rich metals dating to the early periods, and they were regarded as a product of innovative experiments. This might be due to the technical difficulties in smelting zinc from ores and adding it to alloys due to its low melting point and high volatility. It is, however, well documented that in the ancient Urartu advanced metal technologies concerning both casting and working of copper-alloys, as well as ironworking was mastered and applied. This study, thus, aims to shed light on a further metal technology that was developed in the knowledge-environment of the ancient Urartu.

From the North to the South, metals all around: Alloying in the prehistoric Bronze Age sites of Bellapais-Vounous and Kalavassos-Village, Cyprus

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Abstract

Metal procurement and exchange have often been considered the backbone of the socio-cultural changes occurring during the Prehistoric Bronze Age in Cyprus (*PreBA*; c.2500-1700 BCE). Nevertheless, despite some early studies (e.g., Balthazar 1990) and a few more recent ones (e.g., Charalambous and Webb 2020), only a small sample of the island-wide corpus of metal artefacts has been systematically analysed in terms of their composition. Therefore, any inter-site comparison is rather fragile and often misleading. The present analytical work concerns the interdisciplinary investigation of more than 180 copper-alloy artefacts, coming from the *PreBA* sites of Bellapais-Vounous (Dikaïos 1940; Dunn-Vaturi 2003; Stewart and Stewart 1950), located on the north coast, and Kalavassos-Village (Todd 1986, 2007), situated on the south coast of Cyprus. This corpus consists of diverse artefact-types (e.g., weapons, tools, ornaments) originating from multiple mortuary contexts of different chronological sub-phases of *PreBA*, which were non-destructively analysed using a handheld pXRF instrument for determining their alloy-type. These results facilitate the comparison of copper-alloy use both in these two sites and in other contemporaneous sites investigated with similar methodologies (e.g., Lapithos-Vrysi tou Barba). Overall, at least for the latter phases (c.2000-1700 BCE), the predominance of arsenical and unalloyed copper artefacts is clear in both cases, with the presence of tin-bearing alloys and other rare alloys also noted. Tin occurs more extensively in Kalavassos (27%) than in Bellapais (10%), always associated with specific artefact-types, different at each site. This can further be extended to the analysed corpus from Lapithos, and it possibly indicates different manufacturing localities using similar alloys and diverse methods of communal expression associated with these artefacts.

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Metal-making strategies and technological skills in 2nd Millennium BCE Western Anatolia: New archaeometric data from the LBA citadel of Kaymakçı

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Abstract

Archaeometric research on 2nd millennium BCE Anatolian metal industries has played a pivotal role in the discussion of regional and macro-scale phenomena concerning trade and socio-economic networks, craft traditions, and technological knowledge. Within the rich realm of isotopic, metallographic, and compositional studies on Bronze Age metal assemblages, the research on western Anatolia remains limited. Crucial studies have been conducted on the flourishing metallurgical industries developing during the EBA phase, but for the 2nd millennium BCE the focus has been almost exclusively on the north-western and coastal regions. The present study contributes to the enlargement of the available datasets through the analysis of the copper-based metal corpus from the LBA citadel of Kaymakçı (present-day province of Manisa). Through a combination of both compositional and metallographic analyses conducted on ca. 200 samples (via pXRF, EDS-SEM, and OM) this study investigates the characteristics of the metallurgical *chaîne opératoire* adopted at the site, from the evidence of on-site secondary activities to indicators of recycling practices, and from the selection of alloys to the reconstruction of the production steps for every-day tools and ornaments. These quantitative and qualitative data are then tested against anthropological and ethnographic observations on the visual and tactile skills upon which ancient craftsmen often based their technical choices and built their categorizations.

The emerging picture is linked to contemporary datasets within and outside the region to discuss parallelisms and differences in the preference, usage, and manufacture of copper alloys. The aim is not only to discuss the peculiar characteristics of metal industries in what might have been the core of the LBA Seha River Land kingdom, but also to re-evaluate the socio-economic and technological value of metal industries in a region often perceived as a buffer zone between more “complex” political entities developing during the LBA.

Recording the copper slag heaps in the hinterland of the kingdom of Palaepaphos

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Abstract

The project “MEANING: From the metalliferous sources to the citadel complex of ancient Paphos: Archaeo-environmental analysis of the mining and the built environment”, directed by Maria Iacovou and funded by the A.G. Leventis Foundation Projects of the University of Cyprus, was launched in 2017 (Iacovou 2021). It was designed to support the on-going Palaepaphos Urban Landscape Project (PULP), directed by Iacovou since 2006. PULP’s excavations revealed hitherto unknown monumental buildings of ancient Paphos, one of the Late Cypriot polities and Iron Age kingdoms of Cyprus, and the seat of the most famous sanctuary of Aphrodite in the Mediterranean (Iacovou 2019).

MEANING initiated the macroscopic and microscopic study of a wide range of primary data from the built environment and enabled comparison and integration with data extracted from the macro-scale analysis of the catchment of Paphos, especially in relation to the study of copper slag located within the metalliferous foothills of the Paphos Forest (Iacovou 2012). In our contribution we report on the interdisciplinary study of the slag heaps and the small archaeometallurgical assemblage from the excavations at the Iron Age sites of *Laona* and *Hadjiabdoulla*. Twelve slag heaps of various sizes were mapped and spatially recorded with accuracy. Slag samples were collected from two of the largest heaps, namely Pevkos Pera Vasa and Agios Georgios Emnon; they were analysed chemically and microscopically. Their Lead Isotope fingerprint was also determined. This interdisciplinary study comes to fill a gap regarding an important metalliferous area of the island, which was hitherto little known.

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Cutting edge metallurgy: Blade technology in the Late Bronze Age Carpathian basin (The Fall of 1200 BC)

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Abstract

In the Late Bronze Age (c. 1300-1100 BCE), social crises in southeastern European and the eastern Mediterranean culminated in the collapse of highly centralised, hierarchical systems that dramatically transformed prehistoric societies. At that time, a closely similar package of metal weaponry spread across a wide and culturally diverse region including the Carpathian Basin, as periods of social crisis often coincide with high mobility and increased social conflict. Our overarching aim is to reconstruct the circumstances and ideas surrounding the mode of production of these mobile metal objects. We examine the technology of four types of copper-based objects (c. 200 samples) bearing blades including weapons (swords, spearheads) and tools (axes, sickles) from several locations in the Carpathian Basin (>50 find spots) to address questions about the mode of production during these times of change. More specifically, we investigate modes of metal procurement, object making, shaping, and using along major communication routes in the inland Balkans through elemental analysis by micro X-ray fluorescence spectroscopy and metallographic examination on polished cross-section by reflected light microscopy. Results show distinct metalworking patterns for the different types of artefacts, as well as trends within smaller geographical units across the various hoards represented in the sample. Often swords and spearheads show closest similarities including high occurrence of binary bronze alloys with higher tin content, more tightly clustered concentrations and overall fewer outliers, compared to axes and sickles, which are more likely to include arsenical copper / bronze alloys or unalloyed copper, as well as trace element outliers. This work is ongoing, however preliminary interpretations identify patterns of technological organisation between the four artefact types that we believe are directly linked with the intended use of the objects and the messages they communicated as weapons and tools.

New insights on the provenance studies of the Bronze Age copper-based objects from southwestern Iran

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Abstract

The recent archaeological excavations in the southwestern Iran led to the discovery of a large-scale Bronze Age graveyard in the highlands of the Zagros Mountain. The archaeological site, so-called as Deh Dumen graveyard, and its grave goods present an interesting diversity of cultures from eastern, southwestern, and western Iran (Oudbashi *et al.* 2016). This cultural and archaeological diversity states the connection and interaction of the Bronze Age cultures in the Iranian Plateau. Analytical study of the materials from the graveyard can show the probable technological connection between the region and other parts of Iran and can answer questions about the trading of raw materials during the Bronze Age in the Iranian Plateau. The aim of this paper is to perform lead isotopic analysis on some copper-based objects excavated from the first season of excavation of the Deh Dumen graveyard to identify their provenance and contribute to our understanding of interactions between the site and other regions of the Iranian Plateau. Results of previous analytical work showed that these objects are made of tin bronze and arsenical copper (Oudbashi *et al.* 2016; Oudbashi *et al.* 2017). The comparison with data for ore sources show that part of the objects has signature compatible with the of Iranian sources located in the Urumieh-Dokhtar and the Sanandaj-Sirjan, and that three objects are compatible with the signature of objects found in the Gujarat and ore source in the Ambaji-Sendra Belt deposits (Rajasthan and Gujarat), demonstrating long-distance exchange between Deh Dumen (southwestern Iran) and the Indus valley.

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Lead isotope analysis for provenancing: different perspectives explored through a case study on Roman Republican silver coins

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Abstract

Lead isotope analysis has been used to provenance metals such as lead, silver and bronze for many decades. Nevertheless, different approaches to interpret lead isotopic ratios have been proposed. In this study, three methods to couple the lead isotopic signature of archaeological artefacts to their possible mineral resources will be compared: the ‘conventional’ assessment of biplots, a clustering method combined with calculating model ages (as applied by Albarède *et al.* 2020), and relative probability calculations using kernel density estimates (as proposed by De Ceuster and Degryse, 2020). The three different approaches will be applied to a dataset of lead isotopic analyses of 99 Roman Republican silver coins previously analysed, pointing to a primary origin of the silver in the mining regions of Spain, NW-Europe and the Aegean, but showing signs of mixing and/or recycling. The interpretations made through the different approaches are compared, indicating the strengths and weaknesses for each one. This study argues that, although the conventional biplot method gives valid visual information, calculating the relative probabilities via kernel density estimation provides a more transparent and statistically correct approach of which the results can be used in further calculations. The clustering method Albarède *et al.* (2020) applied in combination with model ages looks at the dataset from a different perspective, and it is argued that it can supplement other techniques, but by itself may lose archaeological relevance.

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Copper metallurgy in the EMME

Session chairs: Prof. Thilo Rehren, Dr Myrto Georgakopoulou and Prof. Vasiliki Kassianidou

Poster presentations

Bronze Age copper production at Hala Sultan Tekke, Cyprus: First archaeometallurgical results

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Abstract

The recent Swedish excavations at the Late Bronze Age harbour city of Hala Sultan Tekke carried out under the direction of Peter M. Fischer have brought to light numerous slags and other finds associated with pyrometallurgical activities (Tholander 1978; Fischer 2018, with further literature). In total, more than one ton of slags and raw copper, fragments of tuyères and furnace linings in addition to metal objects, for instance, a donut-shaped ingot of bronze and numerous objects of lead including an ingot, were found. With this poster we present the first systematic study of these objects with the aim of describing the metallurgical processes and technologies from which they derived. In general, two types of slag were identified: the tapped slag (TS) and the furnace slag (FS). The TS are characterised by several layers created by tapping as well as copper matte inclusions with diameters of more than 1cm. The SEM-EDS bulk analyses of them revealed still high concentrations of iron (used device: Leo EVO 60 EVP, EDS unit: Oxford Instruments, Si-Li detector with 10mm², using BAM (e.g. BAM-M376a), MAC (e.g. UNI5532), BIR-1a-NP and other standards). In contrast, the semi-circular to globular formed furnace slags do not show any clear layering. Irregularly shaped gas bubbles, metallic copper and large matte inclusions were identified. The microstructure of these slags is dominated by large olivine crystals (fayalite) several millimetres long. This shows that the smelting process lasted many hours and resulted in the slag cooling down very slowly inside the furnace. In consequence, two smelting steps in two distinct furnace installations can be hypothesized. Comparable morphological and microstructural features were described by Van Brempt and Kassianidou (2016) for the slags found at Kalavassos Ayios Dhimitrios. Pieces of similar shape and surface structure were also found in the settlements of Enkomi and Kition (Tylecote 1982; Hauptmann 2011; Ioannides and Kassianidou 2016). Thus, one can assume that comparable smelting operations were carried out at all four contemporary settlements, which suggests that the technological know-how required was widespread throughout the region.

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The archaeometallurgical transition from Neolithic to Chalcolithic period in northern Iranian plateau: Some pieces of evidence from Tappeh-Zaghe and Tappeh-Ghabristan

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Abstract

The Qazvin Plain is located in the northern part of the Iranian Central Plateau. It hosts notable prehistoric sites like the late-Neolithic/transitional-chalcolithic site of Tappeh-Zaghe “5400-4300 B.C.”, and the Chalcolithic site of Tappeh-Ghabristan “4390-2700 B.C.” in which some archaeometallurgical remains like metal artifacts, slags and the earliest types of pedestalled crucibles as well as molds have been found (Shahmirzadi, 1977; Majidzadeh, 1976; Pollard *et al.*, 2013).

Tepe Ghabristan is one of the most notable sites for the beginning of copper ore smelting in western Asia (Pigott, 2004; Weeks, 2013; Thornton, 2014). Due to the permanent population of the Tappeh-Zaghe and Tappeh-Ghabristan settlements in prehistoric times and their close distance of just 2 km to each other, their metallurgical remains are discussed together to provide a better understanding of the development of archaeometallurgy in the Qazvin Plain.

In this paper, chemical analysis using ICP-OES and metallographic observations on 15 archaeometallurgical remains, including artifacts and metallic ingots from two sites, are presented to get an insight into the early metallurgical technologies in this area. Furthermore, the archaeometric results of this study are compared with those of other prehistoric sites in the region. Their selection is based on the distance and the relative chronologies. Tappeh-Zaghe samples, consisting of pure copper with a minimum of 99.76% Cu concentration, contain various traces of elements such as Ag, Fe, S, and in a few samples’ arsenic and barium. In contrast, Tappeh-Ghabristan metals show that almost all of them are made from arsenical copper with Pb and Sb as additional minor components; a tin bronze sample forms the only exception.

These results let us assume that we can reconstruct several sources which provide ores and allow for a better view of the technical developments in this area, from native copper metallurgy at Tappeh-Zaghe to much more advanced ore smelting at Tappeh-Ghabristan to make some of the earliest Cu-As metal.

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EBA metal objects from Mesi Glyfada sea, northern Aegean, Greece: Preliminary data

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Abstract

In 2008 an archeological hoard of 134 metal objects was found in the sea area between the contemporary settlements of Mesi and Glyfada in the Rhodope Prefecture, in northern Greece. The treasure came to light by the Ephorate of Underwater Antiquities and is consisted of 115 tools, while interesting are the 19 ingots which are considered as the raw material of the tools. Additionally, two bases of Early Helladic handmade vessels were found.

Analyses were carried out on 64 of the total 134 metal finds by the non-destructive XRF method with the portable XRF device of the Laboratory of Palaeoenvironmental and Ancient Metal Structures of the Institute of Nanoscience and Nanotechnology of the N.C.S.R. "Demokritos" for the determination of the alloy type that was used for their production. The results showed that all the tools are made of arsenical copper. Furthermore, the presence of arsenic within the ingots is also interesting. In order to draw further conclusions about the proportion of the components of these items, as well as their manufacturing technology, we sampled 32 selected items and conducted chemical analysis under the Scanning Electron Microscope as well as and metallographic examination to study their microstructure.

The purpose of this paper is to briefly present the analytical results that have been obtained so far aiming to reconstruct the early metallurgical techniques that were practiced in this specific region and in northern Greece in general.

Investigating two Late Roman slag heaps in the area of Polis Chrysochous, Cyprus

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Abstract

Two Late Roman slag heaps located in the area of Polis Chrysochous, western Cyprus, are examined aiming towards the reconstruction of the technological processes of copper production during the late antiquity in Cyprus. The Pelathousa slag heap (4th-6th century C.E.) is located on the foothills of the Troodos Mountain close to the Limni mine while the Argaka slag heap (6th-8th century C.E.) is located next to the coastline at a distance of approximately five kilometers from the mine. Investigation on selected slag samples through macroscopic examination, HHpXRF analysis, optical microscopy and Scanning Electron Microscopy (SEM), showed that the slag from both slag heaps shows the same variability in manganese content, which varies from less than 1% to almost 40%. This sheds some light on the fluxing choices. The slag assemblage derives mostly from copper-matte smelting. The second part of the research focuses on the spatial analysis of the metallurgical remains. With the help of GIS spatial tools, the locations of the slag heaps are investigated in relation to their topographic context and their distance from the nearby mines. The results will be used to understand the organization of copper production within the landscape.

Lime-rich bloomery slags from lime poor ores

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Abstract

We analysed slag and ore samples from two iron smelting sites NE of Beirut, offering rare insight into the iron smelting technology of the 2nd millennium CE. Ore and slag remains were found within a high-altitude mountainous forest environment. Optical microscopy and SEM-EDS analysis revealed a high-grade hematite-limonite ore with less than 10 wt% gangue components. The slag is rich in wüstite in a fayalitic matrix, showing frequent tap lines and chill textures indicative of slag tapping. The slag composition shows wide variation in lime content, ranging from 5 to 25 wt%. None of the ore samples analysed had more than 0.2 wt% CaO, raising the question of the origin of the lime in the slag, whether from calcareous host rock, the fuel ash, or as an intentionally added flux.

From OXALID to GlobalID: A substantial upgrade of a well-known data pool of lead isotopes for metal provenancing using R and Shiny App

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Abstract

Lead (Pb) isotope geochemistry is an approved key method in archaeological sciences to reconstruct the resource provenance of metals and trade networks of the past civilisations. Successful application and interpretation of Pb isotope signatures of metal artefacts rely crucially on the published ore data, which are partly only available from pre- or re-digitalised publications. Most Pb isotope reference data collections were compiled by individual working groups, usually focussing on their projects and regions of interest. A great step towards a large-scale collection of Pb isotope data came with the release of the OXALID database in the early 2000s, which has benefited the scholars in the natural science discipline as well as the more untrained users from the archaeological community. Still up today, OXALID is the most used and cited source for reference data, despite the accumulation of many additional data sets since then. All of them are set up as static data collections, limiting the possibilities to expand, correct, and modify them with the publication of newer results or analyses. Additionally, not all of them are easily available for people from across the world and only recently compilations for regions outside of Europe and the Mediterranean became widely available.

Riding the wave of open science and new data infrastructures, the authors are endeavouring to digitalise and construct a global Pb isotope data base using the statistical environment R and Shiny App. The presentation will demonstrate this highly promising application for the modernisation of archaeometry as an applied geoscience discipline.

An Environmental History of ancient Cyprus: landscapes, plants and animals through time

Session chairs: Dr Evi Margaritis, Dr Angelos Hadjikoumis and Prof. Paul Halstead

Oral presentations

Have Cypriots ever tasted hippo meat? A short presentation of the Cypriot pygmy hippo and the extinction scenarios

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Abstract

Cyprus is an oceanic island (Held, 1989), thus the large mammals that lived on the island before the arrival of man probably had to swim there (Sondaar, 1986), while the small ones must have rafted on floating vegetation (Geer *et al.* 2010). The Cypriot Pleistocene fauna consisted of pygmy hippos, dwarf elephants, genets, mice, and fruit bats (Hadjisterkotis *et al.* 2000; Theodorou *et al.* 2007; Geer *et al.* 2010). According to the 'island rule', large mammals dwarf on islands (island dwarfism), while small mammals grow larger (island gigantism) (Valen 1973; Lomolino 2005). Herein, we focus on the Cypriot pygmy hippopotamus *Hippopotamus minor* Desmarest, 1822 that decreased its body mass by 96% compared to its mainland ancestor *H. antiquus* coming to an estimated weight of 132 Kg (Geer *et al.* 2018; Lyras 2019; Lomolino 2013). The absence of predators, the limited resources, the size of the island, the distance from the nearest continent, interspecies competition and the duration of isolation are some of the elements influencing the degree of dwarfism on islands (Lomolino 2005). The studied material comes from the Akrotiri-Aetokremnos fossil site and the excavations that Simons contacted from 1987 to 2006. We age-graded all the 932 *H. minor* mandibles that were available using the method of Laws (1968) and we constructed life tables comparing them with the life tables of modern *Hippopotamus amphibius*. The results propose the birth of one offspring per female per year, the occurrence of mating and birth seasons and that death occurred by natural causes such as accidents, genetic abnormalities, and endemic diseases rather than catastrophic causes (Nicolaou *et al.* 2020). Hunting by prehistoric humans whose tools were found in proximity with the hippopotamus bones (Simmons 2000) is not justified by the life tables that have been produced. The use of the wet rockshelter of Aetokremnos as a living area during the day, in the same way that extant *H. amphibius* use lake water, is instead proposed as a probable explanation for the extensive accumulation of bones.

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From hippos to cattle: the fragile relationship of early Cypriots with their animals

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Abstract

Islands provide constraints on both their human and animal populations. In Cyprus, there has been a complex and intricate relationship between the two. Here I examine the island's first inhabitants during the Epipaleolithic through the Pre-Pottery Neolithic. I focus on the controversial role of humans in the extinction of the endemic pygmy hippopotamus. I then examine people and animals during the island's permanent settlement during the early Neolithic.

At Akrotiri *Aetokremnos*, the earliest (ca. 10,000 cal. BC) site on Cyprus, we claim that there was a direct relationship between humans and hippos. *Aetokremnos* has been controversial for over 30 years, with critics disavowing the hippo/human connection. This is important, as it relates to the controversial role of humans in Pleistocene extinctions, a topic that has been debated for decades. We argue that Cyprus' earliest humans were the "last straw" leading to the extinction of these unique animals, already vulnerable to the stresses of the Younger Dryas. Opponents believe that the association of over 500 hippos with cultural remains is fortuitous. They typically have ignored multiple lines of evidence pointing to a connection between humans and hippos. Here I summarize some of the issues involved.

During the subsequent Neolithic, Cyprus was permanently settled. These populations had to import both animals and plants for a successful adaptation. We now know that the Cypriot Neolithic was as early as that on the mainland, and that the early settlers often relied on hunting wild deer and managing possibly feral populations. During this time, limited amounts of cattle also were present, although previously they were not believed to have been in Cyprus until the Bronze Age. By the end of the early Neolithic, they had disappeared. I present some ideas on why this occurred.

I conclude with remarks on how the landscape of Cyprus contributed to a complex human/animal dynamic.

Historical dynamics of the human-environment interactions in Cyprus during the 10th-8th millennia cal BC: the last 30 years contributions of the Amathous area (Limassol district)

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Abstract

The interdisciplinary approach and analytical tools applied in the last 30 years in the Amathous region, especially at the sites of Shillourokambos and Klimonas, generated a huge quantity of archaeological, geoarchaeological and bioarchaeological data. They significantly contributed to document the interactions between the early Neolithic human societies and their environment and natural resources, during this pivotal period when both the climate and the human subsistence strategies underwent through radical changes. This presentation will review these changes through several insights: hydrological changes and their impact on the establishment and preservation of Neolithic sites; plant and vertebrate faunal evolution, especially as a consequence of the introduction of new wild and domestic species; birth and evolution of the commensal fauna (e.g. mice, cats, crows); local domestication of wild boar and goats; adaptation and intensification of cultivation and breeding to the local environments. Altogether, these insights can support a heuristic regional scenario for a better understanding of the first step of the anthropisation of the Eastern Mediterranean area.

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Mesopotamian fallow deer and the chase in Neolithic Cyprus: Insights from Upper Mesopotamia, the Levant and greater Syrian desert

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Abstract

Eighth- to 6th-millennium BC faunal economies on Cyprus have long been considered anomalous in comparison with those of the mainland, owing to the stubborn persistence on Cyprus of low-intensity adaptations based primarily on hunting of Mesopotamian fallow deer. In contrast, economic trends in the Levant and upper Mesopotamia at that time are typically described as having been characterised by intensification and specialisation, frequently linked to increasing exploitation of domestic caprines. Whilst the overarching observation that the subsistence strategies of the prehistoric inhabitants of Cyprus were not subjected to the same evolutionary pressures as those of their mainland counterparts seems indisputable, the simplistic duality inherent in prevailing orthodoxy (*viz.* hunting on Cyprus; herding on the mainland) masks considerable nuance in both the Cypriot and mainland archaeological records. This paper considers the nature of predation in upper Mesopotamia, the Levant and greater Syrian desert following the widespread adoption of caprine herding, looking in particular at the extent to which the increasingly specialised, perhaps even commodified, hunting strategies of the mainland 8th to 6th millennia BC diverged from those of earlier periods. Contemporary exploitation of Mesopotamian fallow deer on Cyprus is then evaluated in light of these data, leading to its interpretation as a relict of Pleistocene-style ‘controlled predation’, facilitated by rock-bottom levels of site-occupation intensity and - as others have noted - the probable survival of unhunted ‘game reservoirs’ between catchments. It is concluded that in this, as in so many other aspects of its prehistoric archaeological record, Cyprus actively maintained an affiliation with behaviours and modes of life that had long since been rendered untenable on the mainland owing to the social, demographic and economic consequences of accelerated Neolithisation.

Breaking bread: a review of early Cypriot prehistoric cooking traditions

Leilani Lucas

*College of Southern Nevada, 3200 E. Cheyenne Avenue, NLV, NV 89030***Abstract**

Our understanding of Neolithic Cyprus highlights a separation from developments in surrounding regions, with its unique route to agricultural dependence and possibly divergent cooking culture. Recently it has been argued that the island followed a non-linear and protracted transition to agriculture. This included both a pulling back from crop-based agriculture and a late integration of secondary products including bread. The evidence highlights fluidity in subsistence strategies during the Neolithic and Chalcolithic and a delayed integrated agro-pastoral system in the Bronze Age. This paper summarizes the archaeobotanical evidence and presents preliminary research on prehistoric food and cooking traditions in Cyprus. The evidence for archaeobotanical 'foodstuffs' in Cypriot prehistory is reviewed, and the possibility that bread did not reach its full potential as a staple foodstuff until other economic developments were well-established is proposed.

Agia Marina. New paleoenvironmental insights from the Aceramic Neolithic of south-western Cyprus

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Abstract

In February 2019, the team of the Moni-Pyrgos-Pentakomo-Monagroulli (MPM) Survey Project re-surveyed the archaeological site of Pyrgos Agia Marina, which was mapped for the first time in the 1990s by the French Archaeological Expedition. Originally recorded as an Aceramic Neolithic site, the MPM archaeological research in the area revealed that Agia Marina is a multi-period site that was intermittently occupied from the 8th mill. BCE to the Medieval periods. In winter 2019, an artificial section (AM I) was identified. It is 115 m long and 6 m deep (max depth). It mainly consists of several levels of architectural features, built in large igneous pebbles, limestone blocks and - sometimes- mudbricks. In addition, the outstanding number of fireplaces and hearths points to the presence of a complex diachronic sequence of human occupation and alluvial events with at least five phases of occupation. A second section (AM II) was identified in 2021, probably belonging to the most ancient phases of the site. The first absolute dating gives a chronological span from the beginning of the 10th mill. to the beginning of the 8th mill. BCE. The archaeobotanical analyses, performed on the hand-collected samples on the AM I section, indicates the presence of coastal maquis vegetation, but the recovery of the endemic downy oak indicates the existence of a forest cover near the site. Agia Marina represents also a new site for the spread of cultivated species and gives new perspectives on the possible partial domestication on the island and, potentially, in the dynamics of contacts and isolation with the mainland.

What's different in 2nd millennium agriculture in Cyprus

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Abstract

The exploitation and exchange of natural resources has been a key parameter in the survival and evolution of past and modern societies. Subsequently, specialisation and control of these resources constitutes a major indicator of increasing social complexity. In the Mediterranean, aspects of social change such as urbanisation, technological sophistication and agricultural diversification, intensification and extensification are evidenced from the later fourth into the second millennia BC. Although these developments have been extensively studied in the past, archaeobotanical approaches - and so a whole swathe of crucial evidence - have not been brought to bear on these questions, with notable exceptions. This paper will explore these aspects of research in Cyprus, focusing on the 2nd millennium, through the study of the archaeobotanical remains.

Olive trade in the Eastern Mediterranean: assessing varietal diversity and cultivation origin of olive (*Olea europaea*) from the Mazotos shipwreck (4th c. BCE) using geometric morphometrics

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Abstract

Centuries of cultivation, selection, trade and exchanges all around the Mediterranean have shaped the modern diversity of the olive tree, one of the emblematic tree of the Mediterranean region. The discovery of archaeological olive stones gives us the opportunity to explore the history of olive cultivation and its varietal diversity. Indeed, the analysis of variation in olive stone shape allow the identification of different morphotypes, the interpretation of wild type and the characterization of several domesticated types.

Thousands of waterlogged olive stones have been found in a shipwreck dated to the 4th c. BCE, located off the southern coast of Cyprus, close to Mazotos village, southern Cyprus, at 44 m below the sea level. The ship was probably on its route from the Aegean to the eastern Mediterranean (Cyprus, the Levant or Egypt). The vast majority of the cargo amphorae were from the island of Chios, Northern Aegean. Although most of them were most probably carrying wine, a small number was found full of olive stones. This waterlogged material gives us the opportunity to characterize the varietal diversity of olives cultivated in the Aegean using geometric morphometrics, and to explore the trade of olives in the Eastern Mediterranean during the Classical period. To identify different morphotypes within the archaeological assemblage, 959 olive stones from the shipwreck will be compared to an extended modern reference collection of 17 supposed wild populations and 55 traditional cultivated varieties from various origins (Terral *et al.* 2021). Comparison with material from the Levant and from Greece is expected to give insights into the history of olive diversity in Eastern Mediterranean. Our study aims also at providing clues to the geographical origin of the olives from Mazotos, whose results will be confronted with the carbon stable isotope analysis that revealed their multiple origins (Briggs 2020).

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Bronze Age landscape use and herding practices at Politiko-Troullia, Cyprus

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Abstract

In this paper, we present the results of stable isotope analyses of animal bone collagen, tooth enamel, and archaeological seeds from the Early/Middle Bronze Age settlement of Politiko-Troullia, Cyprus. Bayesian modelling of 21 radiocarbon ages from secure contexts at the site estimates Politiko-Troullia's occupation between about 2050 and 1900 BCE. Our excavations have produced abundant remains of *Ovis aries*, *Capra hircus* and *Dama mesopotamica*, as well as moderate amounts of *Bos taurus* and *Sus scrofa*. Concentrated spatial patterning of deer bones at the site suggests feasting in public courtyards. Our isotope results show a clustering of taxonomic means for $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ for sheep/goat and cattle, which reflects a diet of C_3 plants for these domesticates. A relatively wide range of $\delta^{13}\text{C}$ values among sheep and goat suggests a broad variety of C_3 plants eaten by free grazing herds. Higher $\delta^{15}\text{N}$ values in cattle may reflect provisioning or grazing in manured fields. Foxes, as carnivores, produce predictably higher $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ results than found in domesticated animals. Deer and pig bones provide lower taxonomic means for $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$, suggesting that the villagers of Politiko-Troullia complemented their management of domesticated animals with hunting of wild deer and feral pigs in the woodlands immediately surrounding their village. This analysis is coupled with stable isotope data from modern plants and water sources to infer trends in seasonal mobility and landscape use.

Some comments on the unpublished fauna from Enkomi-Ayios Iakovos (Dikaïos' excavations, 1948-1958)

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Abstract

In 1977 the late Prof. Gunter Nobis studied some of the Enkomi fauna from the excavation of P. Dikaïos of 1948-58. Either he or someone else removed bones and shells from the 6300+ pottery trays. These remains were labeled in ink with the tray number (#2 to #801). Nobis and von Lehman published a paper in 1979 on two weasel skulls from the excavation, but nothing else was published. When Nobis died in 2002 his wife threw away all his notes on the Enkomi fauna.

I found additional fauna in the 6300+ trays (including more fauna from Trays 140 to 759), as well as bones and shells already pulled, bagged, and labeled by Dikaïos but never studied. Some worked and unworked organic remains were pulled by Dikaïos and are now in the Cyprus Museum in Nicosia. These are the few remains published by Dikaïos in his 1969/71 volumes, largely worked items.

Most of the fauna comes from well fills, but there are also remains from sanctuaries and domestic contexts. Many remains so far lack definite contexts and dates (mainly because the original labels are often very different from the contexts and dates given in the 1969/71 volumes).

The majority of the preserved fauna are sheep and goat, cattle, and fallow deer. Some of the cattle are very large.

Rarer are equids (55 samples [27 horse, 23 donkey]), pigs (41 samples), dogs (seven samples [including a LC IIC cut mandible]), two weasels (LC IIC; LC IIIA), one hare (LC IIIA), fish (130 bones from 54 deposits including 82 shark and 11 *Lates* [imported from the Nile River]), and birds (24 bones from 18 deposits), tortoise (four), marine turtle (six), a hippopotamus canine fragment (LC IIIA:2-B, from the Sanctuary of the Double Goddess), an elephant molar fragment (LC IIIA, from the Sanctuary of the Horned God), and two imported ostrich eggshells (LC IIB/C Chamber Tomb 10, with painted decoration; LC IIC-III A:1 settlement, with circular opening for attachment of a spout).

There are also 537 marine invertebrates from 196 deposits. The main forms are: 107 *Patella* (eight deposits), 76 *Cerastoderma* (23), 60 *Conus* (55), 44 *Arca* (23), 38 *Glycymeris* (38), 25 *Naria/Luria* (22), 25 *Phorcus* (13), 24 *Hexaplex* (14). Of note are: 32 *Cerastoderma* valves from an MC III sample in Area III, 13 *Cerastoderma* valves from LC IIC, Area III, Room 79, and 91 *Patella* from the LC IIIA:2-B Ashlar Building (Room 6, Dump A). There are 53 stringable shells, including 11 *Conus*, 10 *Arca*, nine *Glycymeris*, and eight *Patella*. Special shell finds include a LC IIIA:2 *Phorcus* ring from the Sanctuary of the Double Goddess (Room 12), a LC IIC-III A:1 *Conus* ring, and a *Glycymeris* with blue staining inside from the LC IIIA:2 Sanctuary of the Horned God (Room 26).

Worked bones include: bone beaters (33), astragali (27), worked antlers (15), incised scapula (two), and worked ivories.

The Enkomi fauna will be compared with other LC faunal remains from the island, including previously unpublished collections studied by the author (i.e., Kition, Hala Sultan Tekke, Episkopi-Bamboula).

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Animals and plants on ancient Cypriote coins

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Abstract

The variety of coin types of the Cypriote kings (end of the 6th- end of the 4th c. BCE) is striking. Some iconographic numismatic traditions, attached to specific kingdoms, last for decades. However, others vary with the dynasties and the kings.

Animals are much appreciated in Cypriot numismatic iconography. We find animals of the earth, the sky and the sea. Some examples include the lion, the eagle, the bull, the goat, the ram, the horse, the stag, and the octopus. These creatures are used as main numismatic types, although we also discover fantastic creatures as coin types, such as man-headed bulls and sphinxes.

Plants are not as frequent as animals on coins, at least as main iconographic types, with one exception: the lotus flower on the coinage of the kings of Idalion. We observe an assortment of plants that decorate the field of the coins, such as ivy leaves and olive sprays, brunches but also wreaths and grains of corn.

Aim of this paper is to expose the animals and plants represented on the ancient Cypriot coins in order to tackle diversity, influence and attribution issues.

River and societies in Medieval Cyprus: The case of the Xeros River in Larnaca district

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Abstract

The Xeros River is located on the south coast of Cyprus in the administrative district of Larnaca. The *Settled and Sacred Landscapes of Cyprus* (SeSaLaC) project of the University of Cyprus investigates human activity in the valley diachronically through intensive field survey. The project also employs the application of a geoarchaeological approach to shed light on the interactions between human societies and the natural environment, considering alluvial deposits as a suitable indicator of environmental and topographical changes. The geomorphological study uses field observations, radiocarbon dating of alluvial paleosols and laboratory analysis, such as XRF, magnetic susceptibility and granulometry which allow the establishment of a chronological framework of alluvial formation and the river dynamic. This paper focuses on the medieval period in Xeros Valley, a period poorly known in the region, and the relation between the river and societies in the vicinity, as they were recorded during the archaeological survey. At the beginning of the Medieval Warm Period, it seems that the river flow was regular, offering stable topography that can favour agricultural activities.

An Environmental History of ancient Cyprus: landscapes, plants and animals through time

Session chairs: Dr Evi Margaritis, Dr Angelos Hadjikoumis and Prof. Paul Halstead

Poster presentations

Isotopic analysis of pygmy hippo's fossil bone and tooth apatite from Aghia Napa, Cyprus

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Abstract

Fossil skeletal material of the pygmy hippopotamus *Phanourios minor*, excavated from the fossiliferous site in Aghia Napa (Theodorou *et al.* 2004) in Cyprus, were used to reconstruct the palaeoenvironmental conditions. The geological age of the material was determined by Electron Spin Resonance (ESR) dating, and ranges from 11,000 to 13,500 years B.P. (Theodorou *et al.* 2007). The method used to determine the living conditions of this extinct species is the isotopic analysis of carbonate bioapatite of bones (femurs and tibias) and tooth (canines, incisors and molars) samples. This material will possibly shed some light on the palaeoenvironmental regime during the time when the hippos lived in the area and the skeletal material accumulated at the site, allowing for taphonomical observations.

The analysis was performed at the Stable Isotope Unit, at the NCSR 'Demokritos'. Specifically, the study of stable isotopes can be based either on the extracted collagen or the skeletal material's bioapatite. In our case, all attempts to extract collagen failed and the material was totally dissolved during purification. Thus, the analysis continued based on the study of the phosphates and carbonates of the bone and tooth bioapatite. In the case of teeth, tooth enamel was preferred. Furthermore, several possible effects that may affect the isotopic composition of apatite were investigated, including age, sex, tooth type and diagenesis (Clemenz 2012; Dotsika *et al.* 2011).

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Tooth enamel microstructure of the dwarf hippo *Phanourios minor* from Aghia Napa, Cyprus

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Abstract

Tooth enamel microstructure exhibits unique diversity that contributes to the identification and classification of mammals, depicting their phylogenetic relations. This feature has been proven to be an indicator of dietary adaptations and biomechanical stress due to its unalterable nature (Koenigswald and Pfretzschner 1991; Koenigswald and Sander 1994).

As far as the enamel microstructure of the species *Phanourios minor* (an endemic dwarf hippo of the Upper Quaternary, located in Cyprus) is concerned, there is but little information (Pfretzschner 1994; Stathopoulou 2005). The objective of this study was to describe and interpret the particular traits of its enamel in comparison to *Hippopotamus amphibius*. Scanning electron microscopy was used in our study, because when it comes both to archeological and paleontological findings, SEM is considered essential for the observation of specimen histology. The dental material, which was processed, consisted of ten molar teeth of the species *Phanourios minor* from Aghia Napa and two teeth fragments belonging to the species of *Hippopotamus amphibius* (courtesy of the University of Bonn).

The enamel microstructure of the species *Phanourios minor* was characterized by specific enamel types (primitive, modified, radial enamel and horizontal Hunter - Schreger bands) but did not exhibit the structural specificity we had been looking for. Its differences to the species of *Hippopotamus amphibius* were also indicated, thus allowing for their discrimination. Apart from the enamel microstructure, further findings have provided us with evidence beyond our objective, consistent with the observations concerning bioerosion. We have identified structures such as odontoblast processes and filaments on the surface of dentine (Kalthoff *et al.* 2011). Hopefully in the future, the systematic documentation of enamel microstructure in *Phanourios minor* species, could prove to be more informative about its past and habits.

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Macro- and micro- botanical remains hand in hand: the cases of Bronze Age Alambra-Kato Lakkos and Agios Sozomenos-Ampelia (Cyprus)

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Abstract

Archaeobotany has the potential to reconstruct agricultural and culinary practices, which are indicative of the organization of individual households and whole settlements. As a result of methodological innovations, new strands of research have been integrated to the field of Archaeobotany in the last two decades. Starch granule analysis is a relatively new field of archaeobotanical research, and when combined with macro botanical remains it can serve as a valuable source of information for the better understanding of culinary practices, creating a link between the available ingredients (macro botanical remains) and the cooked foodstuffs (starch granules from food-related artifacts such as pottery cooking vessels). The sites of Alambra- Kato Lakkos and Agios Sozomenos-Ampelia, recently excavated by the Department of Antiquities of Cyprus, offer complementary case studies for combining the study of macro (carbonized seeds and fruits) and micro botanical remains (starch granules) in order to explore agricultural and culinary practices in an Early Middle Bronze Age cemetery (Alambra- Kato Lakkos) and a Late Bronze Age settlement (Agios Sozomenos-Ampelia). This is the first time that both types of archaeobotanical proxies are studied together on Cypriot archaeological sites. The main aim of this paper is not only to reconstruct the diet and agricultural choices of each site but also to stress the importance of setting sampling strategies and methodologies in the field, which aim towards more comprehensive and concrete results concerning the role of plants and their interactions with different societies.

Modelling Settlement Transformations in the EMME region

Session chairs: Dr George Artopoulos, Dr Katherine Crawford and Dr Iza Romanowska

Oral presentations

EIDOS of a city: simulating the collapse and resilience of ancient Eastern Mediterranean urban environments via agent-based modelling

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Abstract

The Eastern Mediterranean, a politically dynamic and environmentally sensitive region hosts some of the world's oldest civilizations and longest records of urban evolution. Despite the importance of cities in the long-term development of human societies, the mechanisms that lead to urban decline, socio-economic collapse, and urban resilience within this region remain understudied. Archaeology has been a leader among humanities disciplines for the applications of formal modelling paradigms. While agent-based modelling (ABM) has been extensively applied to modern urban contexts, only a few models have questioned ancient urban dynamics. Due to existing models capturing socio-environment interactions, we are now in a good position to investigate how different societies dealt with urban processes. The lack of previous engagement has been largely dictated by the micro-level nature of datasets available to social scientists studying contemporary communities, which simply do not extend over large scale, long-durée perspectives. Marrying these two research avenues - models and methods developed for modern urban systems with data spanning centuries and large geographical regions can advance our understanding of long durée processes driving city evolution during the past.

The paper will present interdisciplinary research perspective that aims to investigate the mechanisms that contributed to the parallel change and transformations of cities in the network of urban habitats of the Eastern Mediterranean. The research addresses important questions concerning the phenomenon of urbanization: why do some cities fold at the first sign of turmoil while others, seemingly similar, thrive; what are the dynamic, emergent and complex interactions between growing and deterritorialised (dying) cities within a meshwork of urban environments, from antiquity to early modern times? What components of an ancient city enabled it to be integrated and incorporated into cities of later periods, sometime spanning to our modern period? The EIDOS project will enhance the current dialogue about questions of urban sustainability and resilience by: i) linking for the first time large scale and *longue durée* historical and archaeological record with formal modelling methods; and ii) developing cross-disciplinary dialogue between humanities, computer science and geosciences through tools that are harnessing state-of-the art technologies and their critical humanities-driven application.

Meta-population theory for settlement pattern analysis: Movement, Colonization, and Depopulation, in 16th-20th Centuries Galilee

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Abstract

Population movement, colonization and abandonment are major themes in archaeology and human geography. Questions derived from these themes are crossing periods, regions, and cultures. What can be learned from the abandonment of sites and regions? Why do settlements and communities of different periods present different environmental and spatial settings? And how do technological inventions and/or social organizations drive and reshape the changing settlement landscape? Common explanations highlight deep social, technological or environmental change as the main drivers of such processes.

In this lecture we explore the role of stochastic processes as an alternative to the prevailing approaches in settlement pattern analysis. To this end, we use the ecologically-based meta-population theory, developed to explain species colonization and extinction processes in biogeographic studies. This theory holds that in every demographic process there is a significant stochastic basis, and that changing patterns do not necessarily derive from specific niche requirements.

In the present study we use this theory as a null hypothesis for a re-examination of settlement colonization and abandonment processes in northern Israel during the 16th-20th centuries A.D. Detailed historical, archaeological and cartographic data enable accurate presentation of the location of settlements, their population and economy. Using the meta-population theory, we analyze settlement stability in relation to site size and connectivity. Following the examination of the pre-modern era, we examine similar processes using settlement data from the 4-3 millennia B.C. in the same region.

Patterning pastoral nomadism: MaxEnt modeling of Bedouin sites in the Judean Desert

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Abstract

Archaeological and ethnoarchaeological studies of pastoral nomads in Levantine deserts focused on the analysis of individual encampments, using intra-site patterning of architectural features and artifactual remains as keys for decoding ancient sites associated with pastoral societies. A high-resolution field survey conducted in the southern Judean Desert, Israel, offers a new perspective on regional exploitation patterns of semi-nomadic pastoralists. During this survey, ca. 200 sites belonging to several site types (encampments, stations, single-vessel deposits) were identified in random 25-hectare samples scattered across the harsh, arid landscape. Over 80 percent of those sites were dated to the Late Ottoman and British Mandate period, representing the last wave of pastoral nomadism in this region. We used MaxEnt modeling to analyze environmental patterning of site locations in relation to cultural parameters (site type, size and artifact density). The analysis of the survey results indicates distinct locational preferences of encampments at the regional level, in clear correlation with the regional west-east and north-south environmental gradients and potential resources related to pastoral subsistence economy, whereas stations and single-vessel deposits are more randomly distributed. The study provides an ethnoarchaeological model that can be further used for comparative investigation of regional exploitation patterns of ancient pastoral societies.

A fast parametric approach to model historical city blocks: from geodata to H-BIM

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Abstract

Aim of the work presented here is the definition of a parametric modeling protocol that allows, in a short time, the acquisition, modeling and analysis of urban aggregates. H-BIM methodologies have proven to be effective methodologies for transitioning from digital survey to information models of the historical built heritage. However, this type of procedure requires considerable surveying and modeling time. Therefore, H-BIM is not easily applied to the urban and territorial scale. The key to implement this analysis at the territorial scale lies in the way of acquisition of urban data (geometric and informative) and their management within appropriate modeling environments that allow their treatment (Avena *et al.*, 2021).

The research involves the use of direct data (on site surveys) and derived data (available geodata) for the realization of a City Information Model (CIM) (Xue *et al.*, 2021; Xu *et al.*, 2014) (Figg. 1, 2). As computational design work environment we chose Grasshopper (GH) with an application of Google REST APIs for speeding up data collection through accessible Google Forms templates. The methodology is composed of four progressive phases that constitute the structure of the proposed workflow for the definition of a parametric CIM model capable of covering from the territorial scale to the data related to each building unit (such as metadata and geometries associated to the single buildings) up to the automated generation of IFC model of each unit. To create the CIM, we used as reference the sequence of levels of detail (LODs) of the international standard CityGML (Fig. 3).

This research focuses on the definition a pipeline scalable and affordable that could be applied both in huge historical urban centres and small settlements. The ease and automation of data collection makes this procedure accessible even to non-specialists. This procedure allows expeditious survey campaigns, particularly useful in areas subject to various forms of risk.

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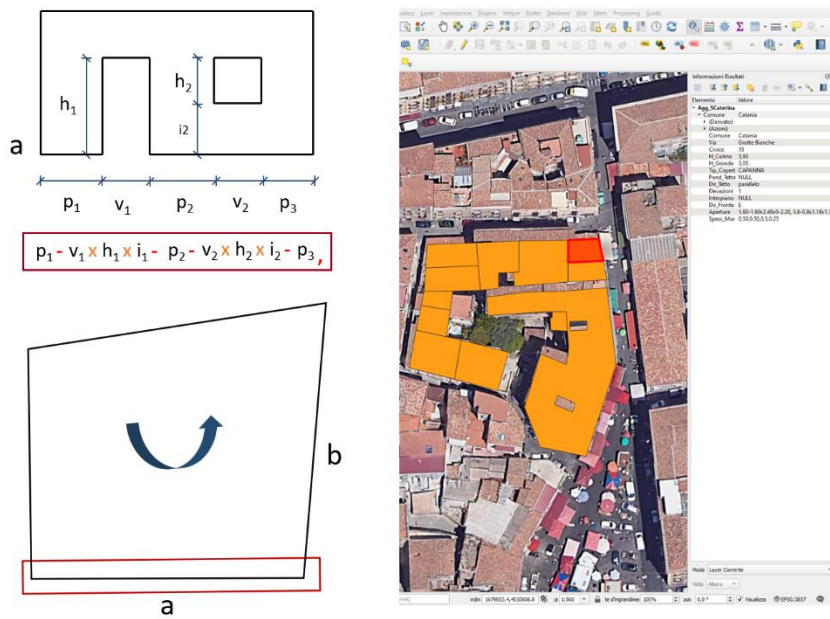


Fig. 1 | On the left: conceptual scheme of the draw-to-string convention used for openings. On the right: data insertion in the shape file (QGIS).

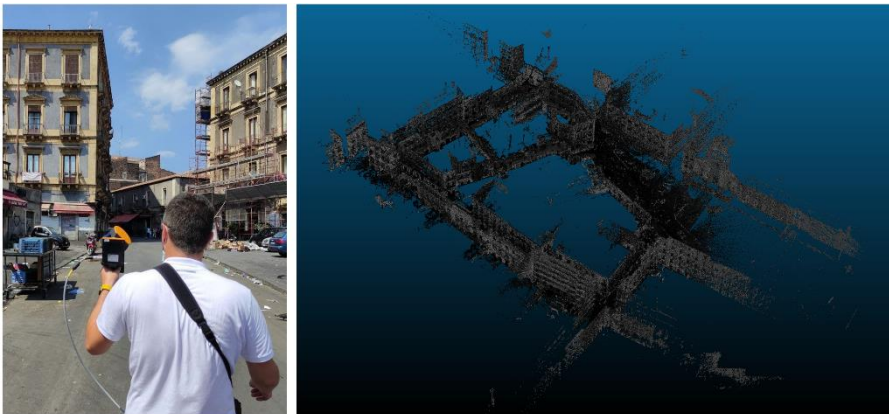


Fig. 2 | Expeditious acquisition of the point cloud using GEOSLAM ZAB Horizon.

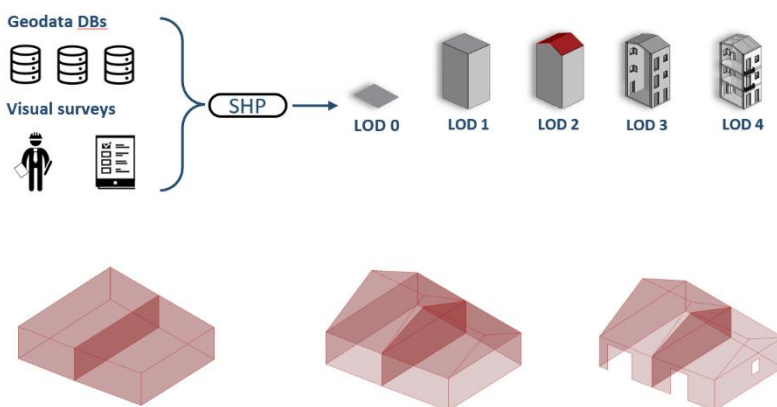


Fig. 3 | Conceptual scheme of the workflow proposed according to CityGML standards.

Scientific Analysis of Ancient Glass in the EMME region

Session chairs: Dr Artemios Oikonomou and Dr Daniela Rosenow

Oral presentations

Exploring Mycenaean glass world via a combination of state-of-the-art techniques

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Abstract

The ubiquity of Mycenaean glass in palatial and funeral contexts highlights its importance as an index of societal and technological evolution. Relevant research revolves around key-queries related to the provenance of raw materials, whether imported in the form of ingots and/or previously shaped artifacts, via exchange routes over vast geographical areas. Traditionally, research has been favorable to linking provenance of Mycenaean glass to either Egypt or Mesopotamia.

In the current study, fifteen (15) beads and relief plaques dating to the Late Bronze Age Era from the Argolid, previously analyzed via SEM-EDX and XRF (Zacharias *et al.* 2018), were investigated at the New AGLAE facility of the C2RMF in the Louvre Museum via external scanning micro-PIXE. The upgraded design and instrumentation integrated at the New AGLAE external Ion Beam Analysis station allows the holistic examination of the artifacts' surface and, thus, ~cm² areas can be scrutinized within a reasonable time with micrometric spatial resolution (~40 µm). Scanning micro-PIXE suits ideally the compositional analysis of the glass matrix offering additional capabilities in fingerprinting trace elements toward provenance assignment and technological study. Moreover, the simultaneous recorded Rutherford Back Scattering spectra provide evidence of the presence of an altered glass matrix, thus, securing the reliability and representativeness of the PIXE results. The data acquired via the three techniques- the first to date comprising micro-PIXE application on Mycenaean glass-formed a compositional data set of improved accuracy rendering it more reliable.

The statistical analyses yielded compositional similarities among the samples that form two major compositional groups, which could be associated with an Egyptian origin. In addressing their coloration, at least two cobalt colorants can be identified, based on their arsenic content and cobalt- associated impurities.

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Micro-Particle Induced X-ray Emission was conducted at the Centre for Research and Restoration of the Museums of France (C2RMF), Palais du Louvre, within the framework of the IPERION CH (Horizon 2020 - Work Programme 2014-2015 for European research infrastructures).

The project was partially funded by the project CALIBRA/EYIE (MIS 5002799), implemented under the Action "Reinforcement of the Research and Innovation Infrastructures," funded by the Operational Programme "Competitiveness, Entrepreneurship and Innovation" (NSRF 2014-2020) and co-financed by Greece and the European Union (European Regional Development Fund).

Preliminary spectroscopic results on glass circulation in the Iron Age Mediterranean from the perspective of Central Italy: the INGOT-EL project

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Abstract

As a preliminary step of a multidisciplinary research project named “INvestigation of Glass Origin and Technology in Etruscan Lands (INGOT-EL)”, this work reports the results obtained by investigating a set of archaeological glasses recovered from Iron Age burials in Central Italy. The existing body of literature, that includes chemical analyses of glasses (Arletti *et al.* 2010; Conte *et al.* 2019; Towle *et al.* 2001), suggests strong cultural and trade links between Tyrrhenian Italy and the Eastern Mediterranean through the Greek or Phoenician trade network (Naso, 2017 and the references therein). These links included the import of glass in the form of ingots (chunks) or finished items, and the archaeological context of the glass finds considered here fits well into this perspective. A non-invasive *in-situ* approach with portable equipment was implemented to analyse beads in the National Etruscan Museum of Villa Giulia and the Museo delle Civiltà (both in Rome, Italy) by means of Optical Microscopy (OM), Fiber Optics Reflectance Spectroscopy (FORS) and X-Ray Fluorescence spectroscopy (XRF). For some beads, the data were also collected using a Scanning Electron Microscope coupled to Energy Dispersive X-ray spectrometer (SEM-EDX). These analytical methods provided information on the content of some major and minor elements in glass, as well as the presence of specific ions and inclusions that give the glass its color. The morphological and compositional data allowed for technological characterisation of the glass making and the working processes used in bead making. Some variability in the minor elements content was interpreted as possibly linked to the region of provenance, though this result is just the first step on the way of the more comprehensive laboratory work that is envisaged for the next stage of the INGOT-EL project.

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New analytical investigation of material from the fourth century CE glass workshop at Jalame, Israel

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Abstract

Although it is generally agreed that a major source of 'Roman-Levantine' glass of the 1st to 4th centuries was somewhere on the Eastern Mediterranean coast, the precise origin of this glass type remains unknown. Pliny refers to the sand at the mouth of the river Belus as a major source (Nat. Hist. XXXVI: 190) and a potential location is therefore in the Haifa Bay. Primary glass making furnaces and primary and secondary workshop debris have been identified at the site of Jalame which lies in the southern part of the Bay. However, the dating evidence for the glass workshop is the second half of the fourth century CE (Weinberg 1988), a time of transition from Roman to Byzantine modes of glass production.

In a seminal study, Robert Brill published analyses of the Jalame glass but a detailed analysis suggests that it has a somewhat different composition, e.g. slightly higher alumina contents, than earlier Roman glass thought to have originated in the Levant. Given the advance of analytical techniques since 1988, a first logical step towards identifying the 'Roman-Levantine' production is a thorough up-to-date characterization of the slightly later fourth century production at Jalame to identify differences.

Here we will present a representative dataset obtained by new EMP, ICP-MS and MC-ICPMS analysis for the Jalame glass that defines a comprehensive elemental and isotopic composition. This new study includes the re-analysis of selected materials analysed by Brill (1988), as well as a range of previously unanalyzed glass. In addition, we have analysed examples of furnace debris and production waste, with the aim of investigating the potential influence of the furnace wall on the glass composition. It is intended that this dataset will provide an important reference point in the investigation of glass from the first half of the first Millennium CE as well as address the issues noted above.

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Chemical analysis of Roman-Byzantine glass artifacts and islamic bracelets from the archaeological site of Dohaleh, North Jordan

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Abstract

A project is underway to compare the variations in glass composition between sites in Jordan. The presentation will discuss the first results of the investigation of the chemical composition of thirteen glass artifacts of Roman and Byzantine periods and twenty-nine glass bracelets of Islamic periods. Analysis was undertaken by electron microprobe. The glass samples were selected from the glass assemblage uncovered during the excavations that took place during the last decade of the past century at the archaeological site of Dohaleh, north Jordan. The study aims to reconstruct their production technologies, shed light on the origin of their raw materials and coloring agents, and show if they undergone mixing or recycling. The results will be compared to those of other studies of glass objects of similar dates in Jordan and neighboring countries.

Furnace linings, glass chunks and contamination processes in Byzantine glass production at Apollonia, Israel

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Abstract

It is generally accepted that during the first millennium CE the primary production of raw glass was largely concentrated in the south-eastern Mediterranean. The past decade has seen increasing application of glass compositional analysis for provenancing. While relatively few production centres have been subjected to detailed analysis, glass objects are frequently assigned to compositional groups which are believed to reflect broad areas of origin. Attention is also focused on the use of compositional data to investigate. A firm understanding of the origins of the compositional variation of ancient glass is required to produce robust conclusions from these types of study.

Apollonia, Israel, was the source of large quantities of primary glass in the sixth to seventh centuries CE, and glass production there is comprehensively reported. Newly excavated materials from both primary and secondary production have been analysed by Scanning Electron Microscopy with Energy Dispersive X-ray analysis (SEM-EDS), X-Ray Diffraction analysis (XRD) and thin-section petrography.

This work and Chen *et al.* 2021 suggest that lime linings were used in both primary and secondary furnaces in the Byzantine southern Levant, although evidence of lime layers is weaker in primary furnaces due to long firing times. The linings protected the molten glass from reaction with the mud-brick made furnace, and appear to have allowed the cooled glass to be easily separated, however, they have also elevated the lime content in the glass. Resultant contamination can help explain compositional variations in glass vessel assemblages.

It is likely that compositions of primary glass from furnaces may not be fully representative because of some contamination, not only lime but also from alumina where the lime parting layer has fully reacted with the glass, exposing the ceramic furnace wall. These contamination characteristics are helpful in distinguishing primary and secondary processes at production sites.

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Metal prills in primary glass: a puzzling additive to the production process

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Abstract

Primary glassmaking involved the fusion of raw materials to produce large chunks of raw glass, which then were distributed in secondary glass workshops and fused into objects. Primary glassmaking during Roman and post Roman periods was conducted in large heating installations, the so-called tank furnaces, in two main regions of the East Mediterranean, namely the Levant and Egypt. Especially in Israel, a large number of tank furnaces in various sites such as Apollonia, Bet Eli'ezer (Hadera) and Jalame have been discovered, giving new insights regarding the technology of glassmaking in the 1st millennium AD.

In this paper, we investigate the existence of rather pure metal prills embedded in raw glass chunks at the contact with a tank furnace floor. The glass chunks were found in a refuse pit at Umm ez-Zinat, southern Carmel, Israel, and are dated to the Late Roman-Early Byzantine periods (fourth-early fifth centuries CE) based on glass vessels found with the debris of primary and secondary production. We analysed glass chunks that contain several prills, some of which embedded in the furnace floor, to understand the morphology and chemical composition of the prills. Seven prills from Umm ez-Zinat were analysed chemically, six embedded in glass and one without glass attached to it, and three prills from Bet Eli'ezer, the massive glass industry dated to the seventh-early eighth centuries AD, were also analysed investigated to compare any similarities/differences between the two sites. The prills were investigated with an optical USB microscope to identify surface features and were further analysed in cross section using a p-XRF to make bulk analysis and finally a SEM-EDS to understand the nature of metal and the interaction layers between glass-metal-furnace wall.

Results show that the prills vary greatly in shape and composition. Their morphology ranges between rounded spheres to asymmetric ellipse, all showing inclusions indicating the source material was inhomogeneous chemically. The prills from Umm ez-Zinat are mainly lead, with minor contribution of copper (Cu), tin (Sn), antimony (Sb) and silver (Ag) as inclusions. The three prills from Bet Eli'ezer show two are copper (Cu) alloyed with lead (Pb), and one which has a lead matrix with various copper inclusions. We investigate possible scenarios to understand the nature of the metal in the glass, how and when was it added to the glass melt, and possible technological and ritual interpretations for its presence.

Glass from the Silk Roads. Insights into new finds from Kafir Kala (Samarkand, Uzbekistan)

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Abstract

The paper aims to provide insights into an assemblage of glass finds from the citadel of Kafir Kala (ancient Samarkand, Uzbekistan). Located along one of the major Eurasian branches of the "Silk Roads", Kafir Kala is among the most relevant centres to better understand the "Islamization" of Samarkand area after the Arab conquest in the early 8th century CE (Mantellini *et al.* 2016). Archaeological research carried out since 2001 by an Italian-Uzbek mission has underpinned evidence for a continuity of occupation between the pre-Islamic (second half of the 7th CE - beginning of the 8th CE) and Islamic phase (8th-10th CE) (Mantellini and Berdimuradov, 2005). During the excavations, hundreds of fragments of ceramics, wooden and leather objects, and a conspicuous amount of glass finds were recovered. Chrono-typological study, performed on a selection of glass fragments from pre-Islamic and Islamic phases, allowed identifying objects for everyday use like bottles, cups with handles and bowls with re-folded rims; fragments of decorated bottoms with a honeycomb pattern, showing a distinctive rosette stamp, were also identified (Meyer 1992; Hadad 2005; Gorin-Rosen 2010). Compositional analyses (EPMA) have been carried out on selected fragments, aimed at investigating the compositional features of finds from the pre-Islamic and Islamic phases of occupation to establish comparisons with published assemblages pertinent to neighbouring geographical areas and comparable chronological spans. All the glass fragments from Kafir Kala are silica-soda-lime in composition, and the majority are made by using plant ash as fluxing agent. The correlation between chrono-typological and archaeometric data shows evidence for the occurrence of glass objects linkable to Syrian-Palestinian influences (cups and bowls), together with artefacts showing decorative features typical of the Fatimid and Abbasid ages (bottles and bottoms with stamps).

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The Gulf between glass: Using various advances in glass analytical approaches to trace the origins and distributions of Islamic glass bangles across the Gulf region, Middle East and beyond (9th-18th centuries CE)

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Abstract

The intention of this project is to better understand the increased dissemination of glass bangles across the Islamic trade network from the 9th–18th centuries CE. A primary focus is using advances analytical equipment, including SEM, EPMA and LA-ICP-MS, to identify likely primary production regions of historic glass bangles at various sites during the period.

Past studies noted that glass bangles represent a wide variety of techniques, patterning, colours and finishes – indicative of differences in style according to manufacturing periods and places. However, past attempts at typology focused on only a few collections and rarely incorporated scientific analysis, limiting the potential for identifying likely regional locations of production. At least four regions of glass production have been identified within Siraf glass bangles alone. Now, such an approach has been applied to other regionally local sites to build a more regionally reflective picture of glass bangle trade and dissemination patterns.

This chemical analysis on the glass is designed to also establish whether there are typological correlations with regional glass recipes of glass bangles. To achieve this, a new approach to identifying, grouping and recording major Islamic plant ash glass groups will be discussed along with preliminary results of likely origins found within glass bangles from various sites. Additional insights into slight compositional differences between glass produced in bangles compared to vessels that are likely from the same production region have also been noted. Such differences have wider implications on manufacturing practices and secondary workshops, as well as trade patterns and values to consider.

The eventual goal of such scientific research is to reconstruct the archaeological glass bangle distribution patterns in the Persian Gulf region (and beyond) against other known changes in politics, economy and culture. Such findings may, incidentally, also lead to further insights into the social identity of their wearers.

Multimodal Digital Heritage Preservation in the EMME Region

Session chairs: Dr Dante Abate, Prof. Eva Savina Malinverni, Dr Roberto Pierdicca

Oral presentations

Multimodal Digital Documentation of a 20th century wooden vessel at risk: the AGIOS SPYRIDON project

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Abstract

AGIOS SPYRIDON was a 24-meter long wooden trawler, built in 1950 in Crete. It was registered in Cyprus in 1954 and was used as a fishing vessel until 2004, when it was withdrawn according to EU Fishing Policy. Although the boat was preserved as a monument of the local cultural heritage, it was never properly protected and in 2018 the Municipal Council of Polis Chrysochous / CY decided that the vessel, should be destroyed for safety and aesthetic reasons. Despite all efforts to the contrary, the loss of this nautical monument was unavoidable. In order to mitigate the consequences, the Maritime Archaeological Research Laboratory of the University of Cyprus (MARELab), in collaboration with the Cyprus Institute and with the full support of the Honor Frost Foundation, initiated a project of controlled destruction and detailed recording in 2019, the first of its kind in the eastern Mediterranean.

Although the boat does not exist anymore, critical parts of the hull as well as the engine and the fishing gear, were preserved for further study and a possible future exhibition. During the project, diverse methodological and practical challenges were tackled through the use of digital tools, thus demonstrating the potential of a holistic approach to ship recording. Every phase of the vessel's dismantling was fully recorded, using both conventional and digital methods: A 3D model was produced with photogrammetry and laser scanning, whereas 2D architectural drawings were also used for the analysis of the structural elements of the hull.

This first preliminary report aims to present the results of the project and discuss the potential of multimodal digital approaches for the preservation of nautical cultural heritage and the public awareness-raising about the importance of historic ships in the eastern Mediterranean.

Multi-Sensor documentation of the inaccessible Nicosia International Airport located in the UN controlled Buffer Zone of Cyprus. The NIC Project

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Abstract

During the months of June and July 2021, a team of The Cyprus Institute with the support of the United Nations Peacekeeping Force in Cyprus (UNFICYP), completed the full digitization of the former Nicosia International Airport, today located in the buffer zone and inaccessible.

The Nicosia International Airport (IATA: NIC, ICAO: LCNC) was once the main airport of Cyprus, and is remembered with nostalgia by people all over the island, on both sides of the buffer zone. When the new terminal building opened in 1968, German-designed by Dorsch und Gehrmann and Cypriot-built, it was hailed for the stylish modernity of its design. It was elegant and uncluttered with shafts of sunlight streaming through large circular wells in the ceiling. With increasing numbers of holidaymakers flying in to Nicosia airport on Cyprus Airways and other carriers, plans were announced in June 1974 to expand the terminal and platform again. After the events of 1974, the airport ceased its operations, with its surroundings hosting UNFICYP's headquarters, but the building itself is out of bounds.

The NIC Project (named after the airport's IATA code) focuses on an interdisciplinary 3D modelling and visualization process developed to create interactive applications for virtual tours, since access to the airport terminal building is nowadays deemed unsafe due to years of abandonment and lack of maintenance.

During the initial phase of the project, a terrestrial laser scanning campaign coupled with a mobile mapping system, was concluded to digitize the internal and external structures of the main terminal. Due to the environmental conditions special protective gear was used to comply with health and safety regulations concerning the identified on-site hazards.

For the digitization of the tarmac, the two intersecting runways and the building rooftops a special photogrammetric drone survey that allows for the creation of 3D models out of 2D images, was realized.

At the same time, a panoramic imaging campaign was performed in all accessible areas of the main terminal, the control tower, hangar, and three planes sitting in the airport premises. These materials will be used to create a virtual tour, freely accessible through a dedicated webpage. All data collected will be, to create an immersive experience of visiting the inaccessible spaces of the terminal remotely.

Documenting and reconstructing gaming heritage from antiquity to today

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Abstract

Games are a form of intangible cultural heritage which have received limited attention in archaeological, historical, and ethnographic research. Because games are traditionally taught through interpersonal interaction, the rules for these games were rarely written down before the nineteenth century. While the Eastern Mediterranean and Middle East (EMME) region has the longest continuous documented tradition of gaming anywhere in the world (Crist *et al.* 2016), the rarity of information relating to games from the archaeological record means that the heritage of play is threatened by the same factors that endanger archaeological sites throughout the region. On top of this, even the traditional games played today in the region are under threat of being lost due to other factors. The global commercial sale of games, colonial values emphasizing work over play, and the invention of video games all threaten the continued play of traditional games.

The Digital Ludeme Project is documenting the evidence for the intangible heritage of gaming from the earliest material evidence in Egypt in the fourth millennium BCE until the present day. The focus of the project is worldwide, but the EMME is a particular focus, as the region with the earliest evidence for games anywhere in the world and the richest archaeological record of games. This knowledge is implemented as fully playable games, where possible, in the Ludii general game system, which allows for analysis through the use of Artificial Intelligence playouts (Browne 2020), but the software also has applications when completed rulesets are not known. Rulesets are proposed by identifying which rules are known from the archaeological evidence for a particular game and filling in gaps by borrowing rules from similar or nearby games based on the historical context. This paper discusses this process in reference to the games of the Eastern Mediterranean and Middle East.

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The dynamic digital survey. Integration between digital processes for the documentation of some monasteries in the Gjirokastra area

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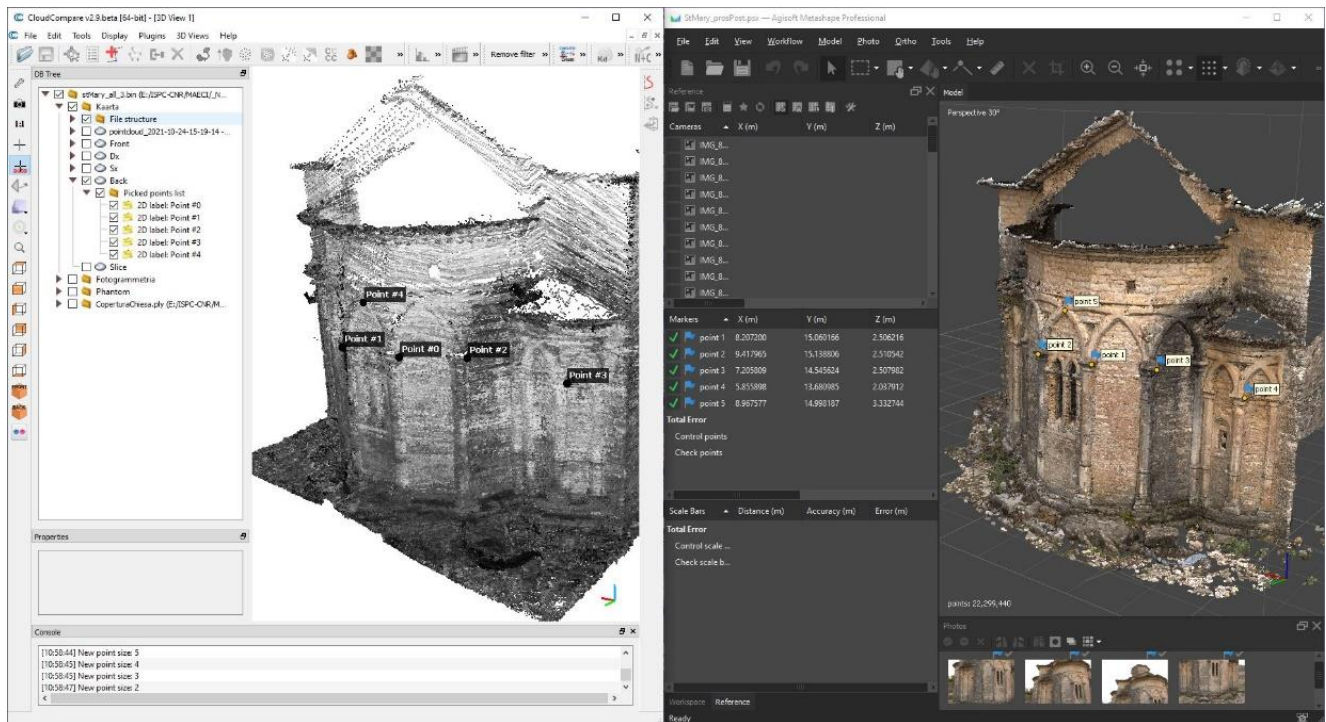
Abstract

The main objective of the paper is to define a survey protocol for the digitisation of inaccessible cultural heritage threatened by time, integrating mobile mapping techniques with photogrammetric techniques. (Di Stefano *et al.* 2020).

The proposed survey aims to implement procedures for the morphological documentation of sites which, due to difficult orographic conditions or the particular state of the artefacts present (historical architecture with problems of consolidation and preservation), are not able to be documented (Calcerano *et al.* 2021), stimulating the use of 'dynamic' digitisation techniques. The term dynamic, refers to the speditive nature of the instruments used (Slam, terrestrial and aerial photogrammetry) and the way in which the data is acquired without long stationary pauses. The use of survey methods with different accuracy (Slam and photogrammetry as examples) (Bolognesi and Garagnani 2018) needs a reliable survey project able to integrate data without the risk of redundancy of morphological information (Bianchini *et al.* 2019).

The methodology was used for several sites in a limited timeframe, but without sacrificing a good resolution of the data in localised areas of artefacts, choosing topics of interest. The data acquisition process on site considered the Slam survey as the numerical connection between the terrestrial photogrammetric survey, used to acquire the external and internal details, and the aerial photogrammetric survey, for the knowledge of the external space and the orography of the terrain.

Some important results were achieved as part of the MAECI mission to develop digital technologies for the study and conservation of post-Byzantine monasteries in the Gjirokastra area. Specifically, we are talking about the monasteries of St. Mary, Goranxi, St. Qirjako and Judith, Dhuvjan and Prophet Ilias, Stegopull. Artifacts that are difficult to reach because they are located in inaccessible areas in the mountains overlooking the Drinos valley in southern Albania, conditions that allowed the experimentation of the presented procedure.



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The archaeological site of Umm er-Rasas: Innovative technologies and training activities for the conservation and enhancement

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Abstract

Umm ar-Rasas is a Jordan archaeological site, located 30 km southeast of the city of Madaba, in the northern part of Wadi Mujib. It preserves findings dating back the period from the end of 3rd to the 9th century AD and, since 2004, it belongs to the world heritage list of UNESCO. Since 2013, a multidisciplinary group led by the CNR-ISPC conducted a scientific mission, aimed at promoting, valorising and documenting this priceless archaeological heritage. As demonstrated by the literature, innovative technological solutions proved to be valuable for different tasks and purposes, especially for archaeology (Pujol-Tost 2019). More in depth, Geomatics acquisitions based on both TLS and photogrammetry allowed to document, with a very high level of detail, the different artifacts present in the site; as well, innovative methods of data processing based on Deep Learning, allowed to automatize those very time-consuming tasks that are nowadays performed manually by expert archaeologists. And more, the exploitation of Geomatics data processing revealed to be crucial for in-depth analysis and to support the delicate phase of monitoring and maintenance of such structures.

In this light, our contribution is aimed at sharing the “backstage” of the abovementioned processes, presenting different pipelines of work. We will argue over the importance of Geomatics in the archaeological field (Skarlatos and Kiparissi 2012), which definitively contribute to sew the different expertise, making the process of conservation, preservation and valorisation really interdisciplinary (Bekele *et al.* 2018). Among the different case studies, particular focus will be given to the information management in GIS (Figure 1), which is pivotal to collect multi-source data, and to the data processing of point clouds and high resolution orthophotos, particularly important when dealing with ancient structures and complex mosaics (Piccirillo 1988). These studies have been mainly performed over the Church of Saint Stephen and on the Stylite tower (Cozzolino *et al.* 2019), standing nearby the archaeological site. Finally, a possible way of sharing the knowledge will be presented in the form of Virtual Tour (Figure 2), realized for the whole site and which has been enriched with some 3D models, manageable directly on the web to maximize the impact to the broader public.

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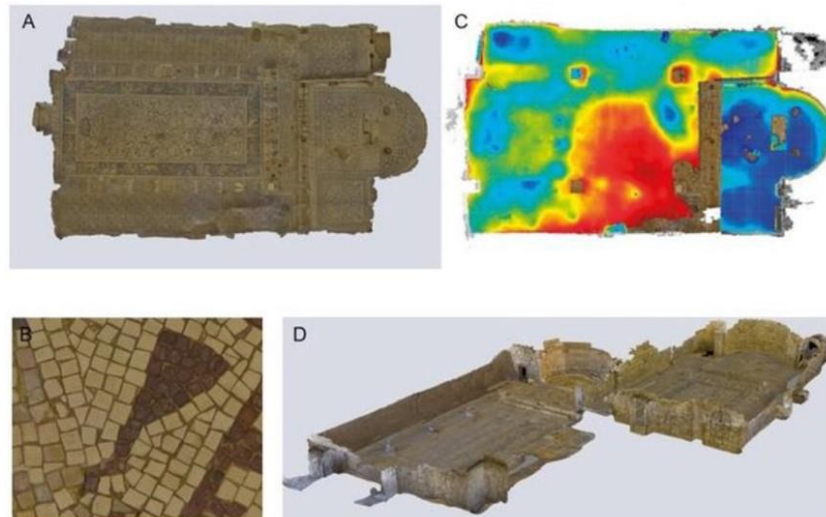


Figure 1. 2D and 3D information to be managed in GIS environment

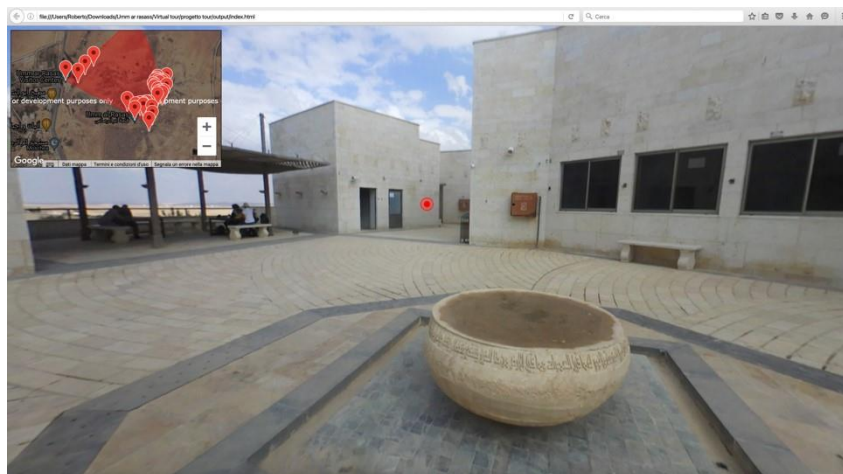


Figure 2. Virtual Tour of Um-Er-Rasas archaeological Site

Digital documentation of heritage and the participation of local communities

Session chairs: Dr Sorin Hermon, Dr Mia Trentin and Dr Anna Foka

Oral presentations

Depicting the past: The value of old maps and topographic diagrams in cultural heritage through GIS

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Abstract

Since it was built in 1573, the castle of Navarino (Niokastro Pylos, Greece) underwent several changes within its walls. The castle was constantly altered to fulfil the needs of its inhabitants. Buildings were planned and built, streets were installed and most of the infrastructure eventually fell into ruins.

Today, this infrastructure is only preserved very rarely. This case study shows the potential of digitizing old maps on the case study of a map of Navarino castle from 1830 and comparing it with today's condition by using GIS. The map was georeferenced and used to create digital maps showing the gathered information. They are presenting a comparison between the historic building infrastructure and the now existing buildings, and the path structures in 1830 and today.

With this reasoning, after the digitization process the exact location of the buildings, the building blocks and the path structures that existed within the walls of Niokastro as early as 1830 were verified, but also it became possible to digitally render the whole picture of the castle infrastructure of that time, or even to locate the foundations of the settlements that were either collapsed throughout the time or destroyed by human interventions. These maps impressively show how the old development plan influenced the present state and will serve as a guide for future research, contributing substantially to the preservation of cultural heritage.

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Reconstructing the memory of the Arsinoe excavation in Egypt. Processes of 3D modelling for the valorization of the archaeological activities of the «G. Vitelli» Papyrological Institute between 1964 and 1965 in Arsinoe

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Abstract

The research project “Digital reconstructions and exhibition itineraries for the storytelling of the excavations of the «G. Vitelli» Papyrological Institute in Arsinoe” aims at promoting the archaeological collection of the «G. Vitelli» Papyrological Institute, which gathers in Florence the finds of the excavations carried out by the institute between 1964 and 1965 in Arsinoe, Egypt – back then capital of the Arsinoites nomos, currently Faiyûm. The mission, directed by Sergio Bosticco with the collaboration of Manfredo Manfredi, brought to light finds dating back to the Ptolemaic and Roman era (3rd century B.C.-2nd century A.D.). The research promotes the digital reconstruction of the excavation and the construction of a virtual environment where to virtually visit the archaeological area, currently buried under the modern city. The production of three-dimensional models supports the analyses and interpretations about the reconstruction of the excavation and ultimately looks towards a digital exhibition, aiming at valorising the collection of the Institute and bring to light an important piece of history. The archaeological area saw an increasing building activity across the years and today barely any traces of the ancient city are left, buried under the new buildings; only a fragment is left visible, enclosed in the centre of a roundabout. The research activities focus on the digitisation of the finds and the three-dimensional reconstruction of the archaeological excavation, starting from historical photographs and dig diaries. Through the orientation of historical photographs and a process of reconstruction of geometries, an immersive environment is created, in which one can interact with the works and the finds discovered in the area but also with the story of the archaeological campaign, reconnecting with a fragment of the thousand-year history of the place.

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The Roman necropolis of Porta Palio in Verona. Rediscovery of the missing places through interactive three-dimensional models

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Abstract

The use of three-dimensional models as visual symbols and medium for the conveyance of graphic information characterizes most of the interventions related to the enhancement of Cultural Heritage (Pietroni and Ferdani 2021) and confirms how virtual systems take on new meanings and functions, amplifying the value in terms of dissemination value of the resulting applications. In order to experience the communicative impact resulting from the elaboration of three-dimensional models in archaeology, a research activity has been developed, aiming to a 3D reconstruction of an imperial-age Roman necropolis, no longer accessible today, discovered in Verona during the road works in 1990 near Porta Palio, one of the main gates to the city (Cavaliere Manasse and Bolla 1995). The greatest challenge in creating 3D models that communicate a no longer visible archaeological site is converting sources, infographics and archive materials into an adequate graphic language. The information synthesis activity aims to define new communication strategies for the virtual narration of inaccessible places, through the development of virtual applications in which drawings and texts become interactive: 3D reconstructions of the main types of graves and excavation allowed to create a digital space, an interpretation of the real one, whose contents will be accessible and easily interpretable. The rediscovery of the necropolis of Porta Palio through interactive three-dimensional models and applications aimed at developing a path of knowledge will serve to create a new network in the local community, raising awareness on to the importance of local history and shared values. For this reconnection with the past to succeed, it is essential that the marks left by history are appropriately conveyed, and the development of virtual applications will become necessary to build new connections with the urban fabric and new "maps of meaning" (Decandia 2019) that allow to assign new meanings to the urban space.

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A 3D high-resolution model of an inner Mani war tower

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Abstract

The area of Mani in the Southern Peloponnese is a unique natural and cultural environment that lacks adequate research attention, since it can stand as a continuous and multilevel educational forum, starting from history to cultural heritage management (mani.org.gr). At the same time, Mani is abandonment by the natives, due to the barren and unprofitable land, makes the need to save and promote its cultural elements imperative. New technologies and especially the possibility of digitizing the material evidences and indirectly the intangible cultural heritage can help to revive the history of the past in the present and the future (unesco.org) (Brunetaud *et al.* 2012; Llobera, 2010). In the present work we attempt 3D visualization through the photogrammetric method of a typical 19th century Mainean war tower. The war tower belonging to the Thomakos family rises on a steep rock and in a strategic historical position, between the bay of Mezapos and the Tigani peninsula. It has unobstructed sea view while inaccessible by land and can only be located through a well-informed local guide.

Photogrammetry contributes decisively to many scientific fields in conjunction with information systems and electronic applications (Sfakianaki 2014). It is based on the basic principles of photography while utilizing the science of geographical information. The world we live in, as we perceive it today has three dimensions; the photographic information we receive is two-dimensional. Photogrammetry, however, offers us the opportunity to visualize the object or our study area in its three dimensions but also to technically add the fourth (time) to our final project (asprs.org) (Ebert 2015). The results of the current study illustrate that new technologies in general and photogrammetric approach in particular can merge science with society while at the same time prompting the dialogue between the next generations towards environmental and cultural heritage sustainability (Grosman 2016).

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A tool for quantitative research on the social awareness for the digitization of cultural heritage: A pilot application

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Abstract

The use of digitization in the field of cultural heritage aims exclusively to serve the needs of its sustainable protection. In that sense, the digitization process is identified as the innovative application of digital technologies to promote the fermentation of civil society with the ideas and values that are embodied in tangible and intangible monuments. Taking these social implications into account, it becomes obvious that the digitization of cultural heritage demands social awareness and participation in the shaping of its innovative interventions. The policies and principles of digitization should be based on that social feedback, which would indicate in a measurable way the level of preparedness of societies to be engaged actively and sustainably in the procedure of protecting cultural heritage.

The variables that are related to the level of social awareness in the field of digitization of cultural heritage are the social need, the social resources and the social behavior – ethos. The social need refers to the existence of the social necessity of the creation of a stable and creative contact between the civilians and the objects of cultural heritage. Social resources are related to the collateralization of the assets for digitization in a social, technical and financial level. Finally, the social ethos concerns the openness and receptiveness of the society to develop a sustainable contact with cultural heritage through the use of digital applications.

Taking the above under consideration, current study aims to present a quantitative tool (a questionnaire) that is formed to measure the social awareness for the digitization of cultural heritage based on the above mentioned variables. The presentation of the questionnaire is followed by the presentation of its initial and pilot application in a sample population.

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Digital documentation of heritage and the participation of local communities

Session chairs: Dr Sorin Hermon, Dr Mia Trentin and Dr Anna Foka

Poster presentations

The use of Remote sensing and GIS in Archeology

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Abstract

Remote sensing is the science, technology and art of obtaining information about an object or area from a distance without requiring field intervention. A Remote Sensor System measures electromagnetic energy reflected or emitted from the objects. It allows us to gather information about a region or a case study too costly, dangerous or hard to reach. This technique is useful in different fields, and has been used increasingly within government, business, education and voluntary sectors. The rapid growth in the availability of spatial data, mainly via remote sensing satellites and other big data sources, provides the potential to map, monitor and understand systems and change in terrestrial and marine environments.

In this presentation, I'm going to present the use of this technology in archaeological fields maritime and on land, starting with the definition and history of remote sensing, and its application. In addition, I'm going to present some examples from Lebanese sites that studied through remote sensing and GIS.

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Ancient Glass Burial Offerings of Children Inhumations from modern East Locris (Phthiotis-Greece): Scientific Analysis of Ancient Glass

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Abstract

This paper deals with two ancient glass burial offerings found in two different children tombs investigated in the course of rescue excavations by the Ephorate of Antiquities of Phthiotis and Evrytania at ancient Hyampolis and ancient Opous in modern East Locris. The first object is a tall blue-green glass indented beaker (shape Isings 35) which is a free-blown product. The cup was found in Tomb II which lies between others tombs immediately to the SW of the south gate of the acropolis of ancient Hyampolis (Papageorgiou and Grigoropoulos *in press*). Tomb II was a simple pit dug into the natural bedrock and contained a single infant inhumation dated to the end of the 1st or the early decades of the 2nd c. AD. The second object, is a core-formed black glass head pendant, Phoenician or Carthaginian, representing an African with pointed beard, bulbous nose, yellow lips, white and black eyes. This pendant is probably part of a larger composition of a necklace consisting of white spherical beads and a three-sided eye bead. The pendant came to light at the organized East Cemetery of ancient Opous (modern town of Atalanti) where a group of limestone statues known as “The Kouroi of Atalanti” (Papageorgiou and Ganetsos 2021) were found in 2018. The pendant accompanied a burial of a child, probably a girl, as the associated finds suggest. The child was buried at a pithos (P2) dating to the second half of 5th c. B.C.

Practical 3D scanning of glass objects is currently conducted via the use of powder coatings. There is a plethora of cultural heritage objects which require digitization and for which a practical 3D scanning method without the use of white coatings would be preferable however this technology is not available yet. In this work we present the practical 3D scanning of glass objects available at the Museum of Atalanti with a practical 3D scanning method, using a white light scanning device from Shining 3D.

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Antiquities in changing rural landscapes: Using satellite imagery and GIS in the regional survey of northern Messenia, Greece

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Abstract

Earth observation technologies are becoming more significant in the cultural heritage management and protection. Identifying changes in urban and rural areas caused by natural phenomena, abandonment and low or non-maintenance, contributes to a better understanding of the contemporary landscapes and prompts their protection from further damage. Residential locations, such as villages and their rural environs, frequently accommodate structures of archaeological interest. Even though these historical structures may be well-known to the local community, they get worn out and destroyed due to the lack of use or adequate maintenance. Since the quality of satellite imagery and aerographic photography has vastly improved, high-resolution photographs are valuable for observing changes in the environment and the surrounds of inhabited sites. We can more effectively monitor the changes that occur in a larger research area with the help of GIS and the use of multilayer maps and data digitalization.

This paper focuses on the rural region of northern Messenia, where the fertile plain of Stenyclaros extended in antiquity. Its aim is to explore the use of remote sensing methods, such as satellite images and historical area photographs, in defining the impact a) of agriculture to antiquities - the case study chosen for this scope is a partly excavated Roman bath complex in the village of Polichni, b) of low-maintained or abandoned rural areas to the monuments located within their boundaries, examining selected monuments (e.g. the poorly preserved church of Hagios Athanasios) in the vicinity of the modern village of Stenyclaros.

Interdisciplinary ceramic studies as proxies for approaching Eastern Mediterranean societies of the 2nd and 1st millennia BC

Session chairs: Dr Maria Dikomitou-Eliadou, Dr Anna Georgiadou and Dr Artemis Georgiou

Oral presentations

Pottery production and circulation at Middle Bronze Age Heraion on Samos, Greece: A preliminary petrographic analysis

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Abstract

The multi-level study and analysis of pottery from the earlier prehistoric strata at Heraion on Samos Island (East Aegean) has led to a holistic understanding of how the production, consumption, and circulation of pottery during the early cultural periods of this insular settlement has evolved through time, bringing to light evidence for the mobility of finished products, knowledge, and people during the 4th and 3rd millennia BC.

Building on our archaeological and archaeometric observations, we have extended that study chronologically to include the analysis of the pottery assemblage dating to the Middle Bronze Age (MBA: 2000-1750 BC) using a combination of macroscopic and microscopic methods. The local production has been characterised and compared alongside the ceramic traditions of the earlier periods at Heraion. Based on preliminary petrographic results and the suggestion of provenance, a number of imported vessels have been identified, reflecting the Heraion's interactions with extra-insular regions through maritime travel and exchange of ceramic products and their contents with the western Anatolian littoral, Mainland Greece, the Cyclades, and Crete. This paper considers ceramic imports as markers of human mobility in the Aegean MBA, a period of intense and well-established exchange networks also due to the emergence of the Old palaces on Crete (1900-1750 BC). The advantageous location of Samos opposite the Maeander Delta, and on natural sea-routes that linked the eastern with the western and southern Aegean, would explain its role as an important node of maritime trade for the emerging 'Minoan Thalassocracy' of the Cretan Old Palaces.

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A diachronic study of culinary practices and pottery use in Minoan Crete: An integrated approach in cooking vessels from Sissi and Malia

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Abstract

Minoan cooking practices and subsistence strategies have been an integral part of the archaeological discourse in Aegean prehistory for the past 20 years, although the focus was largely on feasting deposits and food consumption. However, the spectrum of human activities related with food production and preparation is wide and complex. The study of pottery use can reveal important information on the resources available and the practices of cooking involved, as well as their social repercussions.

This paper reports on the analytical investigation of cooking vessels from two neighboring Minoan settlements, Sissi and Malia, both located in north east Crete. In particular, eleven (11) samples were selected from cooking pottery excavated in Area Pi, district of the Malia palace dated to the Neopalatial period. Another twenty-nine (29) cooking pottery samples were chosen from Sissi dated from Neopalatial to Post-palatial periods and therefore extending the chronological scope of the project.

We propose a combined approach, involving functional study of the pottery and contextual information with organic residue analysis aiming at exploring the resources available, food habits and vessel use diachronically. To this end different vessels of common cooking types were analysed, such as tripod cooking pots, cooking jars and cooking dishes. The data generated to this point reveals the use of beeswax and Pinaceae resins, as well as the preservation of lipids derived from plant and animal fats.

It is anticipated that this study will shed more light on vessel use through time but also on the manifold relationship between food procurement, preparation and consumption practices and the potential of new research methods in their investigation.

Pottery traditions in Kydonia: Results from the petrographic analysis of Late Bronze Age ceramic assemblages from Chania, Crete

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Abstract

Chania, or Minoan Kydonia according to the Linear B tablets, has been an important Minoan settlement throughout the Bronze Age. Systematic and rescue excavation on the hill of Kastelli since the 1970s has revealed the presence of a major palatial centre of the Late Minoan III (LMIIIA1-B1) period that kept thriving even after the collapse of the Minoan palatial system.

This paper deals with the combined analysis of three assemblages from Chania covering all phases of the Postpalatial period (LMIIIA1 to LMIIIB2): the pottery of the 'Warrior graves' cemetery, the Greek-Swedish excavation at the Hagia Aikaterini Square, and the Lionakis plot, the latter two on the hill of Kastelli. The petrographic analysis of an array of coarse and fine wares allowed the in-depth investigation of pottery production throughout the LM III period and the establishment of the main pottery recipes. Issues of provenance and technology of manufacture are investigated with emphasis on the use of different types of raw materials for the production of coarse wares used for domestic purposes as well as semi-fine and fine wares used for transportation and consumption of staples and liquids. With an approach incorporating pottery from different contexts and different chronological horizons of the LM III period we examine continuity and discontinuity in the use of fabrics and clay recipes in time and at a micro-regional level. Last but not least we examine the technological characteristics of the so-called 'Kydonian workshop' producing fine pottery in a characteristic whitish clay and painted decoration that gets distributed across Crete and reaches off-island sites as far as Sardinia and Cyprus.

Combined approach to production and distribution of White Ware towards the end of Late Bronze Age in Greece

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Abstract

White Ware is a pottery class characterized by its distinct sandy fabric, pale surface and predominantly simple decoration, that has been first recognized in 1960s during the excavations of the British School at Athens at Lefkandi, on the island of Euboea (Popham and Miburn 1971). Soon after its initial appearance at that site in 12th century BC, it becomes the dominant ware group during the final stages of occupation. The sheer quantity of White Ware provided a strong case for local production, while the early analyses at the Fitch Lab showed that it was incompatible with local clay beds, and at the same time similar to material from Ayia Irini and Perati (Jones 1986).

Macroscopic study of the entire material from the cemetery at Perati (ca. 1200 complete vessels) made clear that White Ware is equally popular at Perati, and that it is virtually indistinguishable from the material found at Lefkandi. Correlation of macroscopic observations with results of NAA measurements from 1996 highlighted that the majority of WW falls in one of two closely related groups, to which also examples of fineware pottery from Perati belong (Lis *et al.* 2020).

Subsequent combined petrographic and NAA study of White Ware examples from Lefkandi and Eleon (Boeotia) confirmed that this pottery is identical to that of Perati, and was thus produced at the same location. Several lines of evidence, including distribution pattern and most recent discoveries in the area of Perati (Murray *et al.* 2021), make East Attica the most likely production area for White Ware.

With this research, we are able to document a thriving export industry at the terminal stages of Greek Late Bronze Age, and thus a period for which such a level of exchange/trade was not envisaged. In particular, the vast quantities of this pottery at Lefkandi raise important questions as to the mechanisms through which this site, with confirmed production of high-quality pottery in the area, could have been supplied with large quantities of pottery from an area located at a considerable distance.

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Through the pots of the “Sea Peoples”: Provenance studies of tableware from Late Bronze Age Hala Sultan Tekke

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Abstract

In a large-scale study, hundreds of ceramic vessels from Hala Sultan Tekke (HST), one of the major trade hubs in the eastern Mediterranean from the 16th to the 12th century BCE, and raw materials were sampled for comparison both on-site and around the island. Moreover, a combination of ceramic petrography and Fourier Transform Infrared Spectroscopy (FTIR) was carried out to identify the local ceramic industry, foreign imports, and specific Cyprus production centres. This paper focuses on diachronic developments in trade patterns of specific tablewares: White Slip, Base Ring and Aegean-type bowls.

White Slip and Base Ring, among the most distinctive Cypriot ceramic exports across the Mediterranean, are abundant in the harbour city of HST were imported to the site, mainly from the higher slopes of the Troodos mountains. At the end of the Late Cypriot (LC) IIC period (the end of the 13th c. BCE) and the beginning of the LC IIIA (around 1200 BCE), the imports of these hand-made tablewares to HST came to a halt. At the same time, Aegean-imported pottery, well-represented in most Late Cypriot sites in the 14th and 13th centuries BCE, no longer reached HST. Hand in hand, Cypriot produced tableware of Aegean style, so-called White Painted Wheel-made ware appeared, adapting Aegean technologies, shapes and decorations, and combining them with traditional Cypriot characteristics. We additionally recognised intra-island exchanges marked by the appearance of tableware imported from other Cypriot provinces, such as Enkomi, Kalavassos and Paphos. In this study we offer new possibilities to explain the dynamics of exchange, enabling detailed reconstructions of ancient economies and cultural connections across the Mediterranean. Finally, we show that while interregional trade abruptly declined in HST, it was immediately replaced by a different set of economic patterns, including new supply chains served by new producers.

Kinet Höyük, a Cilician Harbour and its Cypriot Connections during the Iron Age

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Abstract

The paper discusses the connections of the Cilician harbour Kinet Höyük with Cyprus during the Iron Age as evident in the ceramic imports. Excavations at Kinet Höyük were conducted by Marie-Henriette Gates, Bilkent University, Turkey, between 1992-2012. Almost 500 ceramic vessels of the excavations were investigated with Neutron Activation Analysis. In addition, petrography was applied to further substantiate the elemental analyses. With these studies, the excavations at Kinet Höyük provide an exceptional wealth of information regarding the connectivity of the Cilician harbour with the Mediterranean and its continental hinterland. The paper focuses on the Cypriot ceramics, which provide evidence for close interactions between Cyprus and Cilicia during ca. 1200-740 BCE. After limited exchange during the LC III, Cypriot imports increase significantly during CG I-II and climaxed in CG III and CA I. The high resolution of the analyses presented here attempts to identify interactions with specific cities on Cyprus such as Salamis. The emergence of the Assyrian empire significantly curbed the imports of Cypriot pottery in the harbour. The paper offers possible explanations for the interactions reflected in the pottery imports.

Late Bronze-Early Iron age pottery from Doghlauri burial ground: understanding the Transcaucasian intercultural relations

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Abstract

In the Late Bronze-Early Iron Age (the second half of the second millennium BCE - the beginning of the first millennium BCE) the Caucasus and adjoining territories are characterized by the variety of archaeological cultures which is reflected in archaeological artifacts, burial constructions and burial rites. Doghlauri burial ground excavated during salvage excavations (Director - Iulon Gagoshidze) of Georgian National Museum is generally regarded as one of the major archaeological sites of that period in the Caucasus region not only in terms of the sheer quantity of excavated burials, but also in area (Gagoshidze and Rova 2018).

Burial ground is located next to the multi-layered mound of Aradetis Orgora (Dedoplis Gora), on which the Georgian-Italian archeological expedition (Directors - Iulon Gagoshidze, Elena Rova) revealed strong synchronous layers of the cemetery and a fortification wall built with large cut stones.

New data, primarily radiocarbon and palynological studies, made it possible to determine the chronological framework of the burial ground and the purpose of the inventory, primarily of various types of pottery. The earliest group of pottery belongs to the so-called transitional stage (15th-13th cc BCE), when the influence of the Kurgan culture of the Middle Bronze Age is still noticeable. The second group (13th-11th cc BCE) is characterized by completely different ceramics, not only in form, but also in the technique of ornamentation. This transformation of ceramics testifies to the social or political upheaval that took place at the different stages of Late Bronze-Early Iron Ages and this is directly reflected on the cultural layers of the nearby fortified settlement.

Alongside with Pottery, numerous metal objects and jewelry from The Late Bronze-Early Iron age complexes of Doghlauri burial ground share common cultural markers that are encountered at contemporary sites of North Caucasus, Transcaucasia and Eastern Anatolia.

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Plaster technology in Iron Age Lebanon: The contribution of Tell el-Burak

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Abstract

Recent excavations at the Phoenician coastal site of Tell el-Burak, a large-scale agricultural production centre in use during 725-350 BCE, revealed the first Iron Age wine press in Lebanon (Orsingher *et al.* 2021). Its remarkable state of preservation enabled a systematic interdisciplinary study of its plaster as well as a comparison with two others plastered installations at this centre. An integrated programme of archaeometric analyses has been applied to samples coming from these three structures. It aimed to investigate the composition of plaster and assess the variability between the winery wine press and the two other building contexts, and therefore further understand the technology required to produce plaster at Tell el-Burak. Petrographic analysis showed the employment of fragments of crushed ceramics as aggregates (grog) mixed with a lime-based plaster (Orsingher *et al.* 2020). A new set of analyses combining ceramic petrography, X-ray diffraction (XRD) and scanning electron microscopy (SEM-EDS) methods now gives further insights into the nature of the binder and allows to debate the influence of the addition of grog into the mechanical properties and hydraulicity of the plaster from the three installations. Overall, the results offer fresh data concerning the composition and technology of Iron Age lime-plaster manufacture, confirming the existence of a local and innovative tradition of plaster production in southern Phoenicia. Accordingly, this investigation contributes also to the wider discussion of Phoenician technology in the broader Iron Age Mediterranean.

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An interdisciplinary study of ceramic loom weights from Archaic and Classical Corinth

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Abstract

Corinth is renowned across the Mediterranean, and further afield, for the production and distribution of pottery, particularly in the Archaic and Classical periods. Whilst most well-known today for its intricately decorated fine wares, a study of loom weights has revealed that Corinth was also an important producer and exporter of ceramic textile tools in the wider Aegean during these periods. An interdisciplinary project running at the British School at Athens has studied these loom weights in relation to the textile and ceramic industries of Corinth with an aim of understanding the organisation of the two industries and how they interacted.

Excavations and the subsequent recording and typological studies have yielded a well-documented collection of over 1,000 loom weights at Corinth. The evolution of the typical Corinthian loom-weight form has been tracked and dating is therefore also relatively well understood, as are the multiple marks which have been imprinted on them during production. However, who made them and how has yet to be explored in any detail. Using a science-based approach (petrography and WD-XRF) this paper will explore this uniquely well studied and large body of material to investigate aspects of their production and makers. Furthermore, it will combine results from the study of these objects from a textiles perspective to investigate cross-craft interactions between these two industries.

Pottery production in Iron Age Salamis, Cyprus. An interdisciplinary study of ceramic fabrics from the city and the periphery

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Abstract

Bringing Life to Old Museum Collections: The Interdisciplinary Study of Pottery from the Cypriot Iron Age Polities of Salamis, Soloi, Lapithos and Chytroi (MuseCo, EXCELLENCE/1216/0093) is an analytical investigation into the regional pottery production of these polities, and it includes the morphological, stylistic, compositional, and technological characterisation of large pottery assemblages that are currently stored at the Cyprus Museum, in Nicosia. MuseCo has been digitally documenting these museum collections and a large number of ceramic samples has been selected for chemical and mineralogical analyses.

The Iron Age pottery of Salamis forms the project's largest case study. Beyond technological and compositional comparisons with representative samples from the other three polities under study, MuseCo aspires to an intra-regional analytical investigation within the polity of Salamis, comparing ceramics from the polity's centre, with those from sites that can be considered part of its periphery, and the polity's political, and socio-economic sphere. We aim at defining and documenting the technological profile of pottery production at Salamis, and the degree of compositional and technological variability within the region.

Following a rigorous sampling strategy, we have designed a diachronic study that stretches from the Cypro-Geometric to the Cypro-Classical period (11th to 4th c. BC) for a study of the evolution of the main ceramic wares, shapes, fabrics and the technology involved in their production. This presentation will include our sampling strategy, the project's methodology, and our first petrographic data, followed by a brief discussion of our preliminary observations regarding the production of pottery within this extraordinary Cypriot Iron Age polity that has been distinguished for its ceramic products within but also outside Cyprus.

Pottery production in Classical Athens through the looking glass: Coexisting potting traditions, workshops and migrant potters

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Abstract

Athens is well known as a potting centre since at least the Geometric period. Its production concerned mainly painted and black glaze pottery, that met local needs but was also widely traded, while cooking ware seem to have been largely imported from the nearby island of Aegina. Recent evidence indicates that in the second half of the 5th century BC, shortly after the Athenians forced the Aeginetan population from the island in 431 BC, these imports stop and a new version of the popular cooking vessels appear in Athens, which in shape and manufacturing techniques were equivalent to their Aeginetan predecessors but they were made of a different fabric, assumingly Attic. It has been argued that this could reflect the presence of migrant Aeginetan potters in Athenian pottery workshops.

The rich and well stratified deposit H 12:6, dated to about 425 to 400 BC, associated with the Tholos in the Athenian Agora, provides an excellent opportunity to understand the nature of this apparent shift and shed light on the dynamics of Athenian pottery production during the last decades of the 5th century BC. The above deposit yielded, beyond the typical Attic black glaze and household ware, a significant amount of cooking ware. In order to reconstruct clay paste recipes, the whole chaîne opératoire of vessel manufacture, and also to understand their association with Attica's landscape resources, we adopted an integrated approach. The latter combines the detailed macroscopic, typological and technological, study of the above deposit's ceramics with the combined application of thin section petrography and elemental analysis using X-ray fluorescence (WD-XRF) of 83 samples representative of all typical categories of Attic ceramic products. To better contextualise results, a wide range of comparative material has been used, concerning both archaeological and geological samples from Attica and Aegina already analysed at the Fitch Laboratory. The results of this study promise a significant contribution to understanding better the complex Athenian pottery industry that apparently comprised a large array of co-existing workshops producing a wide range of fine and coarse wares using a variety of techniques and raw materials, occasionally under the influence of incoming craftspeople linked to different potting traditions.

Hellenistic and Roman fine wares from ancient Elis, Greece: A preliminary study using SEM/EDS analysis

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Abstract

This paper focuses on the archaeometric analysis of a pottery assemblage from the South Stoa (the so-called Stoa of the Hellanodikai) in ancient Elis. The Stoa was in use from the Archaic to the Roman times (Gialouris 1976). Between the 6th and the 4th c. BC, it served as the seat of the officials who oversaw the Olympic Games (the Hellanodikai). Excavations revealed rich findings, such as fragments of glass and metal objects, murex shells, pottery fragments and a plethora of animal bones. The latter in combination with the findings of many lamps suggests that rituals in honour of Zeus took place in the Stoa, as is also mentioned by Pausanias (Papachatzis 1979). The material under examination consists of sixty-one (61) black-glazed, red glazed and terra sigillata drinking pots and other forms of table wares, dated between the 3rd and the late 1st century B.C. The samples were examined both macroscopically and microscopically with the use of Munsell Soil Colour Chart and LED microscopy respectively, for a preliminary grouping of the fabrics. Five (5) distinct fabric groups have been determined. SEM/EDS was used to characterize chemically and technologically the fabric patterns. The main chemical composition is similar for three out of five fabric groups; those differed, present highly siliceous consistency. Technologically, the pots were fired at a temperature between 850-1000°C, which is typical for Hellenistic and Roman pottery production (Mirti 2000). The homogeneity and the thickness of the slip are indications of its good quality. The current combined typological and analytical study contributes towards local and imported fine wares in the region of Elis, which, consequently, may throw further light to social and economic aspects of the Stoa of the Hellanodikai.

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This project was implemented within the scope of the “Exceptional Laboratory Practices in Cultural Heritage: Upgrading Infrastructure and Extending Research Perspectives of the Laboratory of Archaeometry”, a co-financed by Greece and the European Union project under the auspices of the program “Competitiveness, Entrepreneurship and Innovation” NSRF 2014-2020.



Interdisciplinary ceramic studies as proxies for approaching Eastern Mediterranean societies of the 2nd and 1st millennia BC

Session chairs: Dr Maria Dikomitou-Eliadou, Dr Anna Georgiadou and Dr Artemis Georgiou

Poster presentations

Late Hellenistic trade networks through the lens of fine ware pottery from Delos

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Abstract

During the Late Hellenistic period (the Second Athenian Domination on Delos, 167/166-88/69 BCE), Delos played a key role in the trade between the western and the eastern Mediterranean. After the destruction of Corinth in 146 BCE, which up to this date was a major East-West distribution hub, Delos obtained the status of a 'duty-free' port and became a center of the trans-Mediterranean trading network. The 'global' significance of the island during this period has been confirmed by archaeological discoveries, including numerous commercial complexes and an enormous amount of pottery. Previous studies of fine wares from Delos indicated the presence of imports from Attica, Italy, Asia Minor and the North Levant. However, more recent macroscopic examination has suggested the existence of several fabrics potentially associated with regional centers and long-distance imports of different provenance than that already proposed. To verify these assumptions, integrated macroscopic, elemental (WD-XRF) and petrographic analyses were carried out on 127 samples of Late Hellenistic fine ware pottery from excavations in the Sarapieia (A, B, C) and the Aphrodision of Stesileos on Delos. The results provide new crucial evidence for the study of Late Hellenistic networks and the role of Delos as a commercial hub. Additionally, the interdisciplinary methodology adopted in this research underlines the potential of such an approach, even including the application of thin section petrography, for fine wares studies.

A multi-disciplinary approach to pottery from Classical Sikyon: Towards differentiating between pottery from Sikyon and Corinth

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Abstract

The northern Peloponnese provides evidence of prolific ceramic production from all periods and across the entire region, documented in the excavated ceramic assemblages and by the growing number of confirmed production centres and kiln sites. In order to explore questions about the regional economy and organisation of production across various periods in this region it is important to understand how we are able to distinguish between different potting centres. This is made particularly challenging by the homogenous geology of the region—large beds of marly clays, topped with terra rossa, extend from east to west.

This paper will present an ongoing collaborative project between the Fitch Laboratory, BSA, and the “Finding Old Sikyon” project*, which seeks to investigate this issue using a multi-disciplinary and technological approach to Classical fine wares thought to be produced at Sikyon and at Corinth. Here the results of detailed stylistic and typological studies will be combined with results from chemical and petrographic analysis to determine if we are able to differentiate between Sikyonian and Corinthian products.

*A collaborative project between the Ephorate of Antiquities of Corinth, the National Museum of Denmark in Copenhagen, the Danish Institute at Athens, and the Institute of Geosciences of the Christian Albrechts University at Kiel. Funding is provided by the Carlsberg Foundation (Denmark).

Potting traditions of medieval and post-medieval Eastern Mediterranean

Session chairs: Dr Jelena Živković, Dr Athanasios Vionis and Dr Maria Dikomitou-Eliadou

Oral presentations

The Maroneia cave in Aegean Thrace. Transport amphoras and plain pottery

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Abstract

The Maroneia cave, expanding 10000 m², is located in a limestone hill in Aegean Thrace facing south to the Thracian Sea. Its neighboring to the river Platanitis renders it to a safe refuge with easy access to water supply.

E. Tsimpidis-Pentazos conducted a short-scale excavation. Systematic exploration of its main chambers took place 35 years later from the Ephorate of Paleoanthropology-Speleology of Northern Greece.

Its use extends essentially in the Late Neolithic, Early and Late Bronze Age, Late Antiquity, Middle and Late Byzantine period, when the floor had been leveled and a cobblestone was paved. An exceptional quantity of glazed ceramics was revealed. The majority belong to “Zeuxippus family ware”. A large quantity is attributed to the nearby workshops at Mikro Pisto and Mosynopolis and a few imported sherds represent the workshop at Serres. “Black/Green Painted”, “Slip painted” and Monochrome ware also appear.

The present paper aims at the study of the plain pottery of Late Antiquity, Middle and Late Byzantine period. It consists of numerous fragments of transport amphorae, e.g. LRA 1, 2, 5, 8, Bakirtzis Type II, IV, V, pithoi with rope decoration, cooking vessels etc.

The transport amphorae indicate its use as a storage area. The rest findings, i.e. glazed pottery, lamps, clothing accessories, jewelry and a small assemblage of arrowheads indicate that it occasionally served as a place of temporary residence, whenever the citizens of Maroneia were in danger. The repeated invasions and lootings of tribes from the north, as well as the Catalan mercenaries raids and seaward piracy during the Civil war between Andronikos II and Andronikos III probably forced the inhabitants of Maroneia to abandon temporarily their city seeking for shelter in the nearby cave.

The handmade wares of Crusader-Mamluk Bilad al-Sham: Agents of affiliation or demarcation?

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Abstract

The two large corpuses of handmade pottery of the 12th-16th centuries in the area of Bilad al-Sham: the Hand Made Geometrically Painted (HMGP) and the non-decorated utility wares are more often than not considered as two facets of a single industry. Their common manufacturing technique has been considered enough to mark them as representing common tradition. I would suggest that this view should be challenged. As we look for intersection and influence between industries, we should also re-examine assumption of common affiliation based only on broad technological similarities. Looking at the common manufacturing technique, we miss the differences in details of manufacture, and more significantly in distribution - geographic and within assemblages - that suggest differentiation rather than commonality. In this paper I shall examine the interrelations between the decorated and non-decorated handmade corpuses, as well as between each and the wheel-thrown plain utility and glazed table wares, and suggest that these different wares may mark boundaries of social or cultural affiliation.

A pottery context of the Mamluk period (half 13th-14th century) from the so-called Herod's House in the Monastery of Flagellation-Jerusalem

Tiziana Guerrieri

University of Bari

Abstract

The study is about a little group of pottery sherds found in 2017 during the restoration works in a section of the Terra Sancta Museum so-called Herod's House, hosted inside the Monastery of Flagellation in Jerusalem, a pluristratified building in the northern- eastern part of the city, near the al-Haram al-sharif, the Temple Mount.

This research has been conducted during an internship born after a partnership between the DISUM Department of University of Bari and the Custody of Holy Land for the safeguard of franciscan cultural heritage.

The main focus is put on some fragments of Raqqa Ware of the mamluk period, a rare and precious type of pottery, rarely recorded in Jerusalem, made between Syria and Egypt from 12th to 14th century.

The presence also of the aegean graffita ware underlines the primary role of the material culture in the complex background of the Mediterranean koiné and the importance of the Holy Land as a melting pot of so many cultures thanks to the trades led basically by Crusaders from East to West.

Potting traditions of post-medieval Cyprus: archaeological and scientific view on consumption and production patterns

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Abstract

This paper presents the results of cross-disciplinary study on potting traditions in post-medieval Cyprus, focusing on consumption and production patterns of common ceramic wares dated between the 15th and 19th centuries. Ceramic wares included in this study come from archaeological sites located in Ayia Napa, Paphos and Nicosia, giving an insight into the development of potting traditions across the island. Assemblages from Ayia Napa and Nicosia were initially studied by archaeological methods of classification and quantification, which sets the base for the reconstruction of major consumption trends. Furthermore, the scientific analysis of common pottery from Paphos and Ayia Napa, including petrographic, chemical and isotopic analyses, allow the understanding of production technologies, traditions of pottery making, craft organisation of workshops and provenance. The integrated archaeological and scientific results shed new light on the co-existing traditions of pottery making in post-medieval Cyprus and their continuity despite political changes.

Potting traditions of medieval and post-medieval Eastern Mediterranean

Session chairs: Dr Jelena Živković, Dr Athanasios Vionis and Dr Maria Dikomitou-Eliadou

Poster presentations

New reflections on post-Roman apiculture in the Western Messarà (Crete)

Colette Manciero

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Abstract

The beekeeping, linked to the production of honey, was one of the most important and widespread agricultural activities practised by ancient societies. The debate on the subject has led to a growing understanding of the tools and purposes used by humans to manage the production of honey in ancient times.

The Archaeological research on the subject in the geographical context of Crete has focused in the past on the Minoan period and has had as its main source the study of ceramic material, thanks to the discovery of honey hives and extender rings. At present time, the debate helps to clarify many questions related to the dynamics of honey production, circulation and consumption in Crete in the historical period, mainly thanks to the new data taken from excavations and surveys carried out throughout the island.

The resumption of investigations in the area of Festòs, promoted and conducted by the Festòs Project (University of Salerno, 'La Sapienza' University of Rome; Italian Archaeological Mission in Festòs - Italian Archaeological School of Athens - Italy) from 2007 to the present day, has enabled the acquisition of new data, useful for understand how the territory of western Messara was affected, between the end of Roman times and the beginning of the Byzantine era, by this peculiar agricultural activity of a domestic nature, which continues to exist today. The study was conducted mainly on the ceramic material from the excavations and intensive survey, which covered the entire territory of Festòs, from the hills (Christòs Effendi, Acropoli Mediana and Palace Hill) to the plain below, which extends southwest of the ancient Palace and it is currently partly occupied by the present-day village of Agios Ioannis.

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Investigations on pottery use in late antique and mid-Byzantine Hierapolis (Phrygia, Turkey) by organic residue analyses

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Abstract

This work will present the methodologies and the results of a project focused on the functional study of coarse ware pottery and amphorae from some domestic contexts excavated at Hierapolis (Phrygia, Turkey) as part of the research activities of the Italian Archaeological Mission. The study has focused in particular on organic residue analysis carried out by Gas Chromatography-Mass Spectrometry (GC-MS) on pottery samples, in order to identify the original content of the vessels and to obtain information on the function and use of everyday pots in late antique and mid-Byzantine Hierapolis. A selection of coarse wares and amphorae belonging to different morphological types has been sampled for the analyses, including cooking jars, storage jars and domestic amphorae produced between the late 6th/7th and the 8th/mid 9th century AD. The morphology and typology of the selected vessels are well representative of pottery finds retrieved in the late antique and mid-Byzantine contexts so far excavated. The results of the analyses showed the presence of animal fats in some cooking pots, indicating a possible ruminant source for these lipids. Other cooking jars contained vegetable fats probably related to the preparation of legumes or cereals. The results of the analyses carried out on the amphorae indicate the presence of pine pitch, probably used to waterproof the interior walls of the containers, as well as biomarkers of wine, such as tartaric acid. Beeswax has been identified in some amphorae, suggesting the presence of honey. The results of organic residue analysis, combined with morphological and typological data, together with fabric analyses, allow us to better understand the function of common wares in everyday life, as well as to reconstruct cooking practices and patterns of food consumption, storage and preparation within the wider socio-economic context of late antique and mid-Byzantine Hierapolis.

Art Characterization

Session chairs: Dr Nikolas Bakirtzis, Dr Svetlana Gasanova

Oral presentations

Pigment characterization of Maria Auersperg paintings of the 19th century from the collection of the National Museum of Slovenia

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Abstract

The National Museum of Slovenia is keeping two paintings of interiors, which are ascribed to Maria Auersperg Attems (1816-1880). The paintings were examined by a portable XRF apparatus and portable micro Raman instrument. For XRF analyses, 67 points were selected on different colors of the paintings. Measurements were carried out with Hitachi X-MET 8000 instrument using the tube voltage of 40 kV and electron current of 40 μ A. The X-ray radiation was automatically filtered by a Densimet plate. As the apparatus uses a built-in program for the analysis of metal alloys, we extracted the measured spectra, fitted them and calculated the elemental concentration by a procedure, based on independent physical parameters and normalizing to 100% the sum of selected chemical compounds. These were basic lead carbonate (PbCO_3) for lead, BaSO_4 for Ba, HgS for Hg, carbonates for K and Ca, and oxides for the rest. In all points we detected Pb, Zn and Ba, which are related to the white pigment used for diluting the pigments. Both paintings show inverse correlation between Pb and Zn, which reveals a combined use of lead and zinc whites. The concentrations of Ba amount up to 15%, and their linear correlation with Pb indicates mixing of lead-white with barite.

Raman spectroscopy was also used to analyze and identify pigments and determine the palette of color in the two paintings from the National Museum of Slovenia. The Raman spectra were analyzed in the 200-2000 cm^{-1} region using the portable Rockhound Raman spectrometer with a 785 nm laser. We identified in both paintings : zinc white, reab lead, cobalt blue, zinc yellow, red lead and cobalt blue for purple, zinc white and ivory black for grey, Van Dyke (dark brown) or burnt sienna (light brown) and green earth or cobalt green.

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Identification of blue pigments in 18th century paintings from the collection of the Gallery of Matica srpska, Serbia

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Abstract

The 18th century is the period of transition in the art of the Balkans, with living post-Byzantine traditions and many new influences, both stylistic and technical. The collection of the Gallery of Matica srpska holds works of art related to traditional and baroque Serbian paintings from the 18th century, offering good examples for the study. Previous research of the collection did not confirm the use of precious pigments such as natural ultramarine. Therefore, artists used cheaper, more affordable pigments such as azurite and organic indigo, as well as synthetic Prussian blue. The precise identification of blue pigments and the way there were used to produce desired effect on paintings are meaningful for the history of painting techniques and the introduction of new artistic materials in the 18th century.

Identification of blue pigments on selected 18th century works of art was performed using several portable non-invasive analytical techniques such as Raman, XRF and FTIR. Experimental results were discussed regarding analytical challenges as well as artistic background of the painters. Formed conclusions would increase existing knowledge in the history of the use of blue color in the 18th century Balkans.

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Non-invasive mineralogical interpretation of multiband imaging systems: Using spectral indicators in Multispectral Microscope for characterizing pigments of wall paintings

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Abstract

Wall paintings are priceless archives of artistic expressions of past civilizations, which reflect technological complexity through materials and techniques. Characterizing the pigments in painted fragments, and identifying their mineralogical composition is commonly achieved using invasive techniques. Non-invasive approaches are constantly developed for characterizing the surfaces of wall paintings, associating minerals to pigments based on their chemical and structural properties, covering the mm-to-cm scale.

In this work, we present a multi-scale dataset that characterizes pigments in fragments also in the μm -scale, using a full spectrum camera that is mounted on a reflected-light microscope, equipped with UV-VIS-NIR filters.

Mineralogical interpretation is achieved by normalizing the images to have similar reflected intensities at different bandwidths. Then, mineral-specific band ratios are applied on the multiband data, allowing the construction of 2D mineralogical maps by associating minerals to pigments based on their reflected spectra. Spectral indicators that enhance specific minerals were applied on fragments and results show hematite was used in red and pink pigments, black carbon in black, and goethite in yellow. Using multispectral imaging analysis, the distribution of these minerals was mapped in highly degraded samples. Moreover, the introduction of μm -scale analysis provides additional information in multi-layered painted fragments, showing yellow is underlying red in the pictorial layer.

The non-invasive multispectral analysis was verified by high-resolution structural and chemical information from reflected light (FORS), Raman and handheld X-ray fluorescence (XRF) spectrometers. Specific spectral indicators in the visible and infrared bands show full spectrum cameras that are mounted on microscopes with band-pass filters could be used as multispectral documenting tool for mapping pigments at the μm -scale. This tool is very helpful in studying degraded wall paintings, which provide most of the painted fragments in the archaeological record.

Creation of a replica of a Medieval Metal Cross of the Maronite Church of the Holy Cross in Karpasia

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Abstract

Advances in Science and Technology have revolutionized the documentation and study of art and archaeology. Issues of style, iconography, technique, provenance and materiality, addressed through innovative digital and analytical methods, have transformed the history of art, the archaeological method, the preservation of cultural heritage and their relevance for contemporary societies. As a result, these developments offer the capacity for holistic approaches to the characterization and in turn, to the reproduction of exact copies and replicas of heritage assets to accommodate a range of cultural, research and education needs.

This paper showcases how research work at the Andreas Pittas Art Characterization Laboratories (APAC Labs) at the Science and Technology in Archaeology and Culture Research Center (STARC) of the Cyprus Institute (Cyl) informed the creation of such a replica, specifically the copy of a Medieval Liturgical Cross from the Maronite Church of the Holy Cross in Karpasia, Cyprus. The Cross is part of a ceremonial fan (also known as ripidion) and dates back to the late 12th / early 13th centuries. The circle part of the cross is made of bronze (a copper-tin alloy) and the handle is steel (an iron alloy). The original object is kept in the Cyprus Medieval Museum in the Limassol Castle.

The replica of the Cross is the result of the collaboration between The Cyprus Institute and the Cyprus Department of Antiquities for the benefit of the Maronite Church and community. The process was led and coordinated by researchers from the Andreas Pittas Art Characterization Laboratories. The digital workflow for the creation of the replica consisted of several steps including 3D data collection, post processing towards the creation of a waterlight and the material analysis. The waterlight mesh was then 3D-printed into a mold which was in turn used to create a brass copy of the cross by employing the lost-wax technique. The final step was the aesthetic intervention on the surface of the metal replica. The aim of the methodology was to deliver a replica that renders the original as realistic as possible, both aesthetically and qualitatively in color, weight, texture and material.

More recently, the cross was presented to Pope Francis by Cardinal Bechara Boutros Rai, the Maronite Patriarch of Antioch, at the Maronite Cathedral of our Lady of Graces in Nicosia.

Investigation of paintings by scanning XRF

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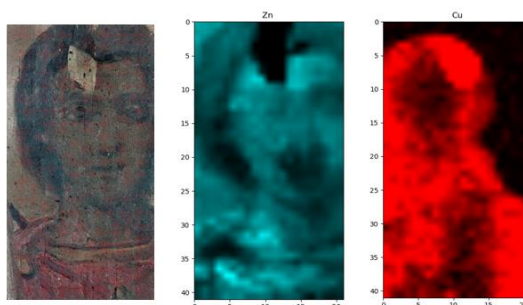
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Abstract

Paintings are often characterized by heterogeneous multi-elemental composition and exhibit a complex layered structure as well. Analytical examination of paintings provides indications concerning pigments identity, painting techniques and state of conservation, while it can also contribute considerably towards resolving inquiries concerning authenticity. X-Ray Fluorescence (XRF) is considered one of the most essential analytical methods used by heritage science for investigation of artworks, as it allows for the non-destructive analysis of cultural heritage objects. In the present work we examine a variety of portable post-byzantine religious paintings (“icons”) by single point and scanning XRF, showcasing the limitations and benefits of each method. Single point XRF analysis proved to be exceptionally useful for materials’ characterization. However, when the latter is combined with scanning XRF of an area one may produce elemental distribution maps which offer extremely useful insights about painting materials and techniques, that lead to an overall better understanding of an artist’s work (Romano, F. P. *et al.*, 2017, Alfeld, M. *et al.*, 2013). Moreover, non X-Ray experts such as archaeologists, art historians and conservators can easily adopt the images produced by scanning XRF and gain a far better understanding of the investigated painting. In the herein demonstrated case studies the spectral analysis and the elemental distribution visualization are performed using the open source PyMCA code (Solé, V. A. *et al.*, 2007) and XISMuS imaging software (Barcellos Lins *et al.*, 2020).



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Interpretation of XRF spectral imaging data using dimensionality reduction combined with clustering algorithms

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Abstract

X-ray spectrometry has proven to be a core, non-destructive, analytical technique in cultural heritage studies because of the non-invasive character. X-rays can penetrate deeper into matter than the visible light allowing further analysis, in order to extract and identify hidden information that exists in the substrate of an artefact. Scanning macro X-ray fluorescence (MA-XRF) (Alfeld *et al.* 2013) combined with computational methods like dimensionality reduction and clustering algorithms enable us to examine with more detail the under-investigation matter. With the use of statistical methods like t-SNE (t-distributed stochastic neighbor embedding) (Garcia-Alonso *et al.* 2014) and PCA (principal component analysis) (Abdi *et al.* 2010) we can reduce hundreds of thousands of XRF spectra in an easily perceived dataset and visualize the high-dimensional data. Furthermore, we are able to plot the result of clustering algorithms like k-means in a low-dimensional space of two or three dimensions. In this work we show how the combination of clustering and spectral information can be used to aid materials and colors identification.



Figure 1: Original Image

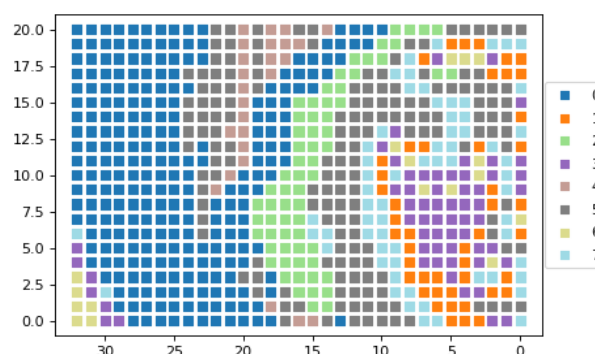


Figure 2: Mapping results of clustering

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Implementing photogrammetry for the analysis of archaeological plasters

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Abstract

This paper explores the use of photogrammetry in the analysis of archaeological plasters. Fragmentary plaster material is often fragile and friable, and at risk of further deterioration if handled too often. Therefore, the need for non-invasive analytical techniques is necessary for the preservation of the material, with photogrammetry offering a means of accessing the material without the need for physical handling, helping to minimise the risk of damage.

This paper tests the use of photogrammetric modelling to evaluate to what extent the study of fragmentary plasters can be enhanced using current 3D documentation methods. The experimental study aims to address the analysis of compositional layers to ascertain accurate measurements. It proposes that in this instance, photogrammetry can provide more accurate dimensions than manual measurements. The test case studies are carried out at the British Museum and the Petrie Museum of Egyptian Archaeology at University College London. The lighting conditions in the museum storerooms are typical for archaeological documentation and so replicate the limitations researchers encounter on fieldwork. The use of normal and macro lenses is tested to determine if there is a difference in the quality of the produced 3D model.

Furthermore, it is proposed that the photogrammetry of plasters can be used as an initial step in sample applications, delimiting the quantity of samples and sample size needed for further investigation, as well as allowing a more efficient process in the analysis of plasters.

Terahertz C-scans of the test object in the spectral range from 0.1 to 2.5 THz

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Abstract

One of the most difficult problems for restorers and technologists is non-destructive studies of multilayer coatings. Traditional methods, such as x-ray radiography, infrared reflectography, give an integrated picture of all layers and it is almost impossible to determine the sequence of layers and highlight the layer of interest. For this purpose, the terahertz time-domain spectroscopy (THz-TDS-based) object visualization system can be useful. Due to non-invasive properties of THz radiation, such a system allows to be applied for investigation of an object of art. The main goal of this study was to test the detecting capacity of such a system to identify layers of paint below the surface. We have used a unique test object, mimicking the most common tasks for painting investigation. The image of paints on canvas was recorded using the TeraPulse LX (TeraView, UK) system with a spectral range 0.06 THz – 6.00 THz. Due to the high sensitivity of THz radiation to the distinction between the optical properties of painting materials, this experiment allowed us to obtain detailed information about the structure of layers of test object and determine the shape of invisible elements without damaging the canvas. Thus, the THz imaging method can be very useful in restoration work designing, determining defects in the structure of paintings materials, as well as when searching for hidden objects under layers of paint.

Art Characterization

Session chairs: Dr Nikolas Bakirtzis, Dr Svetlana Gasanova

Poster presentations

The iconostasis of Panagia Damasta: pigments identification in icons using N.D.T.

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Abstract

On the northern slopes of Mount Kallidromo at an altitude of 740 m, 23 km away from Lamia is built the Monastery of Damasta. There are many versions of the origin of the name of the monastery, but the most prevalent seems to be the version that it comes from the "damastra". Our Virgin Mary tames pain and passions. The Monastery was burned before the years of the Revolution of 1821. The katholikon is preserved almost intact and has been painted in 1818, and its style is cruciform with a dome, eight-sided symmetrical. However, its initial construction is estimated between the 13th and 15th centuries, based on its typology. The painting of the Catholikon was undertaken at his expense by the fighter of the Revolution Io. Diovouniotis, as evidenced by the surviving inscription above the entrance of the Catholic inscription.

The icon of the Virgin Mary, which bears no dating and is housed in the katholikon, is a miraculous, probably a work of the 16th century, and bears a silver-plated investment of the 19th century (1892). The Monastery took part in the revolution and many of its monks fell on the battlefields. In the offer of the Monastery during the years of the Revolution of 1821, the engraved inscription that exists in the courtyard of the monastery is mentioned.

Through the present research we will highlight the fragments of the wood-carved iconostasis - baroque style - that have survived and kept in the Monastery, since after the devastating fire it was replaced by a later one. Specifically, the "Pyramid" of the iconostasis has survived with the "Crucifix" and the "Lypira", that is, the presence of St John and the Virgin Mary. We identified the pigments of the icons using Raman Spectroscopy and XRF portable instruments for in-situ measurements

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Non-destructive study of a 19th century printed silk scarf from the collection of the National Historical Museum of Greece

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Abstract

Aiming at an optimal gel-based methodology for the selective removal of stains on a silk ink-printed scarf from the collection of the National Historical Museum of Greece, a protocol for non-destructive investigation was applied in order to assess its condition and identify the composition of the stains and residues.

The silk scarf depicts the "Temple of the Holy Trinity Greek Orthodox Church of Vienna" (Figure. 1) and was produced between 1820 and 1857 to commemorate Sina's family donations for the renovation of the church (Tsigaras 2017). The object is in poor condition due to extensive staining and the use of adhesive tapes.

Non-invasive documentation techniques by means of technical photography in Vis (Symmetrical, Raking, Transmitted light) and Ultraviolet Induced Visible Fluorescence Color photography (UVFC 365nm), technical examination by USB Dino-lite (Vis, UVFC 55X) and implementation of Hyperspectral imaging system (420-1000nm), as well as Color Imaging and IR False Color Imaging (FCIR) were employed to acquire digital data of the stains color differentiations, of glue residues and document the condition of the silk object (Balas *et al.* 2018; Cosentino 2015; Dyer *et al.* 2013; Warda *et al.* 2011).

Gel systems should be designed, depending upon the chemical composition of the material to be removed and the preservation state of the substrate. Hence, a non-invasive analytical protocol was applied including micro-X-ray Fluorescence (micro-XRF) and Attenuated Total Reflectance-Fourier Transform Infrared spectroscopy (ATR-FTIR) for the qualitative assessment differentiation through as well as the elemental and molecular characterization of fibres, ink, stains, glue residues and deposits (Figure. 2) (Bicchieri *et al.* 2002; Ferrero *et al.* 2004; Gorassini *et al.* 2016; Karydas *et al.* 2005; Romero and Ferrer 1999; Vahur *et al.* 2016; Zięba-palus 2017). Additionally, Gloss and pH measurements and colorimetry were applied to assess the deterioration and discoloration of the silk substrate due to the adhesive tape residues and stains (Hughes 2017).

Based on the results of the above methodology it was possible to create the appropriate gel systems and to successfully remove the stains and residues from the silk scarf.



Figure. 1: micro-XRF spots, line and area scan measurements on printed silk scarf Temple of the Holy Trinity Greek Orthodox Church of Vienna Printed Silk Scarf, 1822-1858 Vienna (566mm width x 633mm length) ©National Historical Museum of Greece NHM Import directory number: 11498.

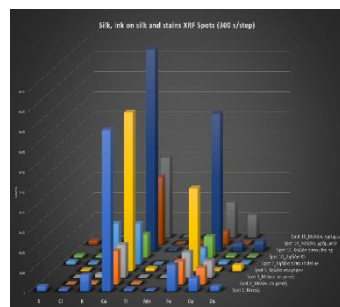


Figure. 2: micro-XRF spot results on printed silk scarf

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Graduate Research in Archaeological Sciences in the EMME region

Session chairs: Meghna Desai, Carly Henkel, Anna. Karligkioti, Mahmud Mardini, Mehmetcan Soyluoglu, Kyriaki Tsirtsis, Chryssa Vergidou and Dr Lindy Crewe

Oral presentations

Fire and bones: A multidisciplinary approach to the study of burned human remains

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Abstract

For many years, the study of burned bones was considered as less valuable compared to the examination of dry remains, mainly because of the fragmented nature and the poor preservation of the burned skeletal material. During the last decade, a growing interest has emerged in European archaeology regarding the study of cremations through the application of macroscopic and analytical methods (Thompson 2015; Snoeck *et al.* 2019). In this paper, the guidelines and standards applied internationally for the recording and study of commingled human remains affected by fire will be analysed and presented. This multidisciplinary approach offers significant insight into the heat-induced changes to the outer bone layer and the crystal and elemental structure of bone during the combustion process. It also provides an opportunity to predict and reconstruct parameters of archaeological thermal episodes, such as the type of pyre, the temperature of the fire and the duration of the burning event/s (Gonçalves *et al.* 2011, Thompson *et al.* 2017; Stamataki *et al.* 2020). Moreover, combined macroscopic and analytical methods can identify degrees of burning intensity, discrete temperature variation between samples burned at low, medium and high temperatures, and the level of decomposition (with or without flesh) of the human remains before their combustion.

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From excavating bones to reconstructing funerary practices: contextualizing skeletal evidence for the post-funerary treatment of the dead at the Prepalatial and Protopalatial Petras cemetery (3000-1800 BCE), Siteia, Crete

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Abstract

This paper explores the character of the Petras human bone deposits in order to identify and reconstruct the original burial conditions and to subsequently understand the social processes that resulted in the formation of a variable burial record. The Petras cemetery, located on the northeast coast of Crete, consists of 23, to date, excavated House Tombs and was used from Early Minoan IB (2900-2650 BCE) until Middle Minoan IIB (1850-1700 BCE), providing an excellent opportunity for the study of Prepalatial and Protopalatial mortuary practices (Triantaphyllou 2016). Drawing on existing research in social bioarchaeology (Aspöck *et al.* 2020; Schmitt *et al.* 2018; Knüsel and Robb 2016; Moutafi 2021), this study implements an integrated bioarchaeological approach ranging from the analysis of funerary taphonomy to aspects relating to bone preservation, anatomical articulation and the position of skeletal remains in order to reconstruct the funerary practices and their meaning. Results suggest that all the members of the community, except for a few intact primary burials, which may reflect a founder population, were at several instances secondarily manipulated often inside the original burial location and while fully or partially decomposed. The remains of the individuals, even the ones placed inside funerary vessels, were reduced and re-arranged in commingled piles of bones in order to create room for new burials. In addition to practical considerations, the latter acts were also part of a ritual programme as the deposition of complete vases to fragmentary remains infer. Moreover, the Petras House Tombs attest to diachronic variability in group size, patterns of use and spatial arrangements of the human remains. Yet, these distinct choices were part of a single narrative which stressed the importance of a collective past as the constant choice of the burial locale, the successive building upon old tombs and the commingled, unindividuated masses of bones indicate.

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Breastfeeding and weaning patterns in ancient Thessaloniki through the analysis of incremental human dentine

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Abstract

In recent years, bioarchaeologists have taken an interest in the investigation of breastfeeding in antiquity, as a means to approach concepts of childhood, familial relations, and the role of women as mothers in the past. Breast milk serves as the pillar of the immune system that protects a newborn from water- and food-borne pathogens and has long-term effects on cognition and health. However, to reach the developmental expectancies, additional foods are introduced in parallel to breast milk consumption. This nutritional stage is referred to as weaning and can be defined as the dietary process that begins with the introduction of soft foods. Nitrogen and carbon stable isotope analysis of incremental dentine collagen has been extensively applied for the reconstruction of these practices in ancient populations with notable results. However, the precise duration of breastfeeding and weaning, is unknown in regions of eastern Mediterranean.

In this study we present the breastfeeding duration and weaning diet of individuals from the site of Thessaloniki (315 BC- 323 AD), a thriving trading center and a cultural hub of Graeco-Roman world. We reconstructed the diet (from birth up to the age of 6 yoa) of 60 individuals from the two large cemeteries of the city based on the measurement of $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ in dentine increments. Our results show a trend in breastfeeding duration (mean weaning age: 2 years old), while several individuals never breastfed. The weaning diet consisted mainly of terrestrial sources (C_3 and C_4 plants, animals/animal-byproducts) or small fish. Our observations are in accordance with ancient texts (e.g. Gynaecology of Soranus) and other isotopic studies on Roman period datasets.

This research is co-financed by Greece and the European Union (European Social Fund ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning 2014 - 2020» in the context of the project "Breastfeeding and weaning in antiquity the case of Thessaloniki" (MIS 5049509).

Where did the sheep go? Combining zooarchaeological and isotopic evidence to assess caprine mobility in Classical-Hellenistic Thessaly, central Greece

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Abstract

Located between the Macedonian empire in the north, and the city-states in the south, Thessaly experienced a long period of political instability from the 4th-1st centuries BCE (Westlake 1969). Short periods of peace and unity among the Thessalian cities alternated with conflicts caused by internal rivals and external intervention. In this context, common herders were practicing their activities and supplying the local markets with meat and other animal products. In this paper, we examine the role of animals in the local economies under changing historical conditions. Through looking at the species composition and kill-off patterns, as well as conducting isotopic analysis on zooarchaeological remains, we attempt to reconstruct animal husbandry strategies and the degree of animal (and consequently human) mobility. Previous research in the region has attempted to examine whether ancient herders practiced seasonal movements (transhumance) for large-scale specialized production or small-scale agrofarming for subsistence. Prummel (2003) proposed the practice of short-distance transhumance of caprines for specialized milk and wool production based on limited zooarchaeological data, while Bishop *et al.* (2020) suggested four different types of management in four caprines based on isotopic evidence. However, further integration of the zooarchaeological and historical evidence is necessary. Although isotopic analysis is a powerful tool that provides us with direct evidence for animal diet and mobility, the results are more effective when they are examined in their historical and archaeological context. For the first time, we bring together new zooarchaeological, isotopic and historical evidence from two neighbouring cities in southern Thessaly, Greece - Magoula Plataniotiki and New Halos (4th-3rd century BCE) - in order to approach animal husbandry practices within a context of continuous political instability. Our analysis demonstrates the predominance of caprines in animal production, the exploitation of several animals and animal products, and short distance movement. The results so far point towards a mixed small-scale agrofarming economy for subsistence.

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High-resolution approaches to climatic variability using shell proxies from Franchthi, Greece

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Abstract

This presentation will outline some preliminary thoughts on archaeological shell proxies and their potential contribution to the reconstruction of past climate and its impact on human communities. Advances in sclerochronology in combination with methods of spectroscopy and chemical analyses have demonstrated that the molluscan record can provide significant evidence for past seasonality and climate. Whereas broad-scale paleoenvironmental and climate proxies have been widely employed to approach the subject, shells present various advantages by giving site-specific information and high-resolution data. For this reason, the climatic variability of the early Holocene has been reconstructed by analyzing shells from the site of Franchthi in the Argolid in Greece. Franchthi, a well-known archaeological site with a long chronological sequence of occupation, constitutes a key site in prehistoric research in the Eastern Mediterranean as it bears witness to various chronological periods and transitions throughout its history of occupation. Thus, this research intends to investigate the climatic variability of the past in order to reconstruct the *human-environment* interactions at Franchthi on a local scale and determine to what extent these were influenced by long-term trends of the climate. The current presentation is part of an on-going PhD project that aims to examine the ways in which the inhabitants of prehistoric coastal sites in the Mediterranean were affected by fluctuations in the local paleoenvironmental conditions in terms of subsistence and social practices using the archaeological shell record, as well as inherent high-resolution paleoenvironmental datasets.

Deciphering formation processes and human activities at the Neolithic lakeside settlement of Dispilio, Greece: A Micro-Geoarchaeological Approach

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Abstract

The micro-geoarchaeological research of the Neolithic lakeside settlement at Dispilio, in Northern Greece, highlights unexplored aspects of diverse human activities by providing insights into the complex depositional micro-histories and formation processes. The context-specific study of deposits from the Final Neolithic (4500-3200) layers, as sampled from the eastern profile of the western sector and from the recently-excavated trench 48.2 in the east, will be added to the existing geoarchaeological background of the site (Karkanas *et al.* 2011; Gkouma 2017). Although the field observations are inconclusive due to the fragmentary preservation of the non-waterlogged horizons, FTIR, pH, magnetic susceptibility, and, most importantly, micromorphology confirm the presence of two types of secondary ash deposits. The first refers to a sequence of compacted *laminae* with high anthropogenic content, possibly related to cooking practices and subsequent dumping, tentatively reflecting activities of individual households. The second group, possibly associated with an open-space discard area, consist of episodic deposits with looser character, showing signatures of intense bioturbation-reworking and longer exposure, compared to the rapid accumulation of the former. Except for the identification of the ashy deposits, the analysis provides further details on the composition and micro-structure of an occupation floor, which is differentiated from previous macroscopic observations, along with the identification of the diverse character of the clay-based structural materials. Overall, this paper highlights the importance of geoarchaeological methods, especially micromorphology, in the study of areas at Dispilio that have been relatively neglected, due to their fragmentary and poorly-preserved character. Moreover, it contributes to the understanding of the various activities of the inhabitants, such as the manipulation of hearth/ash remains or construction practices, and provides the first steps towards the determination of the use of space and its social significance.

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Effective management of archaeological and historical shipwreck sites in the Red Sea, Egypt

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Abstract

Each year, the SCUBA diving industry generates nearly a billion-dollar economy and creates numerous job opportunities; many jobs and dive attractions are found in developing countries. Several of the globe's premiere diving sites, such as the Thistlegorm in Egypt, and Chuuk Lagoon, in the central Pacific, are Underwater Cultural Heritage (UCH) sites that attract many visitors a year (Jeffery 2004; Schofield 2019). It is estimated that the Thistlegorm alone brings in €5 million of revenue per year and attracts thousands of annual visitors to the Red Sea of Egypt (Brown *et al.* 2020; Kean, 2009). When managed effectively, UCH sites, specifically historic shipwrecks, can be intellectually, culturally, and financially enriching for the surrounding community. Seemingly, the lack of oversight, regulation, and education of divers regarding archaeological and historic wrecks places these UCH sites at risk for a litany of issues (Edney 2016). Active threats to preservation efforts include illegal salvage, looting, destruction of archaeological integrity, and increased decomposition of the wrecks and their contents (Abd-el-Maguid 2012; Edney 2016). This research aims to examine the obstacles and methods necessary to develop and implement sustainable management plans to protect and promote public accessibility to historic wrecks. For the purpose of this study, suggestions for effective site plan management will be developed by evaluating three at-risk UCH wreck sites of the Red Sea: The Roman wreck site at Fury Shoals, the 18th century Ottoman merchant ship of Sadana Island, and the Thistlegorm WWII shipwreck. By comparing three separate UCH sites, all with different traits, conditions and circumstances, an effective guide for creating project management plans for UCH can be devised and accomplished.

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Fishing activity in Cyprus through time: an archaeologically neglected aspect of Cypriot society

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Abstract

A review of previous research on fishing activity in Cyprus highlights that the treatment of Cypriot material is historically very fragmented and unequal in coverage and methods. Although research seems to have improved recently on an individual scholar or site basis, it is obvious that it would still benefit from the development of a systematic, interdisciplinary methodology for recording the different types of archaeological evidence. To this end, the author's PhD research project has attempted to gather all the available evidence for fishing activity in Cyprus in a single body of work. This research explores the tradition of fishing on the island of Cyprus through time, from the Neolithic to Early Christian periods, by examining archaeological evidence for fishing technology and fishbone assemblages recovered from a variety of archaeological sites in Cyprus. The iconographic and written sources, as well as the environmental and ethnographic data, are a supporting class of evidence that contributes to the study of fishing as an activity involving interdependent economic, cultural, technological, and environmental aspects. The examination of this evidence demonstrates how the island's cultural and physical contexts determined the presence or absence of fishing activity in the Cypriot maritime landscape. It also contributes towards a more holistic understanding of the relationship between fishers and their maritime cultural landscape, while at the same time helping to reconstruct the fishing technology. According to the available evidence, Cypriots have been diachronically involved in fishing activity and mainly conducted short, daily local-scale trips to exploit both coastal and pelagic resources. Their resulting everyday interaction with the maritime environment has led to the on-going development of local maritime knowledge, which could, in turn, lead to the diachronic growth and preservation of fishing activity in Cyprus.

Graduate Research in Archaeological Sciences in the EMME region

Session chairs: Meghna Desai, Carly Henkel, Anna. Karligkioti, Mahmud Mardini, Mehmetcan Soyluoglu, Kyriaki Tsirtsis, Chryssa Vergidou and Dr Lindy Crewe

Poster presentations

Age-estimation of cremated bones: An histomorphological analysis

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Abstract

Age estimation on burnt human bones, is a challenging task due to the severe modification of the skeletal elements after cremation. At high temperatures (>300°C), bones are severely damaged and standard age estimation methods do not perform efficiently. However, age estimation of cremated individuals is essential for paleodemographic and bioarchaeological studies. To date, there are only a few studies concerning the age estimation of cremated bones, and only one with regression results. In this study, we aim to examine the applicability and reliability of two histological methods on cremated samples and to describe the effect of fire on bone microstructures, and consequently on age estimation. The histological methods tested are from Kerley (1965) and Singh and Gunberg (1970), for which we sampled femur cross-sections of cremated (n=30) and unburned individuals (n=30) of the same archaeological and taphonomic context (Thessaloniki, Metro osteological material, Roman Period 1st-4th c. AD). As a reference we sampled modern femurs (n=8) of known age-at-death individuals from the University of Athens Human Skeletal Reference Collection. For histological sample preparation we developed two protocols, one for cremated and one for unburned bones, and adapted three regression equations: a) total osteon number (Kerley), b) total osteon fragments number (Kerley), c) multiple regression of total osteon number and average Haversian canal diameter (Singh & Gunberg). The poster discusses the challenges of interpreting adult age in skeletal populations, especially when the skeletal material has been severely altered due to specific burial practices i.e. cremation.

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Preliminary investigation of an indigenous Sicilian village: the case of Sant'Angelo Muxaro in the first millennium BCE

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Abstract

The Sicanian settlement of Sant'Angelo Muxaro extended its influence over the middle Platani Valley (central-south Sicily) between the XIII and the V century BCE. Although the material culture and funerary architecture of this territory show a strong connection with the Eastern Mediterranean cultures (e.g. Mycenaean, Cypriot), a biological perspective is largely lacking. The latest excavation of the necropolis, which took place in 2006-2007, has returned 100 tombs and a massive amount of osteological material which has remained unstudied. This poster focusses on the skeletal remains from Tombs 11, 18, 68 and 68A, which provide important preliminary insights to the biocultural identity of the Sant'Angelo Muxaro community. In specific, the current study includes a taphonomical analysis, which is strongly linked to the funerary practices, demography (minimum number of individuals, sex, age-at-death), and pathological lesions of diverse etiology. Additionally, this study encompasses metric and non-metric dental traits in order to establish kinship patterns at an intra-cemetery level, and human mobility at an inter-cemetery level. The integration of the above lines of evidence provides important information on the dynamics involved during the Greek colonisation of the island.

Diet reconstruction of the population of ancient Ambracia during the Archaic and Classical period: Stable isotope analysis ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) from bone collagen of human skeletons

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Abstract

The organized population dispersion during the first millennium BC termed the 'Greek colonization' is one of the most intensively studied subjects of Greek history. This phenomenon included the foundation of colonies across the Mediterranean and Mainland Greece and the intense exchange of goods, ideas, and people, not only between the colonies and the Mediterranean, but also between the colonies and the local inhabitants. Ambracia was founded by the city of Corinth in 625 B.C. on the banks of the river Arachthos at the northern coast of the Ambracian gulf. Its geostrategic position at the crossroad of southern and northern Greece made the colony a melting pot of cultural exchange and population expansion, which particularly thrived during the classical period (480-323 BC). This study aims to reconstruct palaeodietary patterns in the ancient colony of Ambracia. We use stable isotope analysis, an established method in bioarchaeology to characterize diet, physiology and mobility of past populations. We report isotopic data ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) from bone collagen of 48 human skeletons from the western cemetery of ancient Ambracia dated to Archaic (N=10) and Classical years (N=38). Our results show that terrestrial animal protein played a pivotal role in the dietary habits of the population with lesser contribution of C3 plants, while marine resources were not preferred. Comparison between the two periods demonstrates the absence of C3 plants during the Archaic period, whose consumption started mainly during the Classical period. We could not identify considerable differences in dietary practices between males and females. Similar results have been reported from other isotopic studies on Archaic and Classical period datasets from ancient Greek colonies. Our observations shed light on the intensely debated subject of cultural exchange during the second Greek colonization and present dietary patterns at a time of cultural transformation in Mainland Greece.

Diet in the Roman Province of Macedonia: Implications from the isotopic evidence

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Abstract

This paper presents preliminary results of stable isotopic analysis on two contemporaneous burial sites (1st to 4th c. CE) in the Roman Province of Macedonia belonging to two diametrically different communities in terms of micro-ecology and connectivity. The first burial site (Nea Kerdyllia, site Strovolos) is located on the coastal lands of the easternmost administrative district of the province, in close proximity to the port of Amphipolis and the Via Egnatia, while the second one (Pontokomi, site Vrysi) is found in a semi-mountainous and relatively remote area of the westernmost provincial administrative district of Upper Macedonia. In total, more than 100 adult human bone and several dozen animal bone samples have been prepared for stable carbon and nitrogen isotope analysis with the intention of detecting the impact of micro-ecology and differential connectivity on the diet, and consequently the health and lifestyle, of the two communities. Initial results suggest the diet of the two communities was significantly different from each other. These results are discussed in the light of previously published macroscopic data on dental and skeletal pathologies of the Pontokomi-Vrysi assemblage. It is expected that this study will make an important contribution to the emerging corpus of bioarchaeological research on Roman Greece, a time period that previously has been largely neglected.

Dental health in Roman Phoenicia: A comparative study

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Abstract

The strategic location of the Lebanese coast in the Eastern Mediterranean and Middle East (EMME) facilitated easy access to the Syrian, Anatolian, and Mesopotamian interiors, as well as the participation in maritime networks across the Mediterranean. This allowed the Levantine coastal cities to actively engage in the exchange of goods, ideas, and people, establishing dominant commercial enterprises in the EMME region. While historical and archaeological evidence have offered important insights into the economic and social structure of Lebanese coastal city states throughout historical time periods, human bioarchaeological research has yet to be incorporated into relevant discussions when compared to neighbouring countries such as Syria and Jordan. In this study, we use dental health markers, such as dental caries, dental calculus, ante-mortem tooth loss, enamel hypoplasia, and dental wear, in individuals from Byblos, Beirut, and Tyre to understand dental health inequalities and differential access to dietary resources. Dental diseases and wear are compared at an inter- and intra-cemetery level to examine trends between and within the different coastal cities. The interpretation of the results recognizes that oral health is influenced by a variety of factors other than nutrition, such as salivary flow rate, hormones, oral hygiene and others. Despite these potential limiting factors, this research offers significant information on the diet and non-specific stress of human groups along the Levantine coast in the Roman period.

Ottoman-era Cyprus: A bioarchaeological comparative study

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Abstract

Active human bioarchaeological research started early in Cyprus (during the 1920s), and while a significant number of bioarchaeological articles (>191) can be found in published literature when compared to other neighbouring countries in the Eastern Mediterranean and Middle East (EMME), there is little to no bioarchaeological knowledge about Post-Medieval or Ottoman-era communities from the island (Nikita *et al.* 2021). Rescue excavations by the Department of Antiquities in 2019 - 2020 brought to light 16th - 19th c. CE primary and secondary burials from the Ayia Napa Monastery and the Panagia Panagiotissa Chapel. 19 adults and 22 juveniles have been retrieved from the Ayia Napa Monastery compared to 13 adults and 9 juveniles from the Panagia Panagiotissa Chapel. The preservation of the cortical bone surfaces aided in the identification of pathological lesions, particularly in juvenile bones, revealing important details about the health of children in both coastal regions. Macroscopic osteological methods have been utilized to identify trends in activity (entheseal changes, osteoarthritis, Schmorl's Nodes), dental health (dental caries, dental calculus, enamel hypoplasia, dental wear), trauma, and other pathologies (genetic anemias). Employing osteological data, this study addresses an important gap in our biocultural knowledge of the people who lived in Cyprus throughout the Ottoman period and promotes the understanding of regional resemblances and dissimilarities during Ottoman rule.

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Approaching diachronic life (ine)quality and identity formation in Eastern Attica from the Classical to the Roman era

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Abstract

Even though Classical Antiquity in Greece is thoroughly studied both in relation to its history and archaeology, bioarchaeological studies of historical-era assemblages are extremely few. Existing research has focused only on specific case studies and has been influenced by a positivist application of physical sciences in archaeology, rather superficially attempting to bring together human skeletal material and the respective archaeological and historical context (reviews in Buikstra and Lagia 2009; Lagia 2015; Nikita and Triantaphyllou 2017). Furthermore, research has focused principally on Athens, leaving the rest of the Classical world largely unexplored (Humphreys 1980; Morris 1992; Closterman 2007). Humans are physical mediators of the interaction of cultural and natural phenomena, thus, by combining osteoarchaeological evidence of life quality with mortuary data and historical information, valuable insights can be gained regarding the biological dimensions of socio-politically constructed identities and notions of kinship, citizenship and ethnicity diachronically. To address the above topics, biocultural determinants of identity expressed through health inequalities, differential access to dietary resources and activity patterns were examined in rural populations coming from the Messogeia plain in Eastern Attica, that temporally span the Classical, Hellenistic and Roman periods. In the given paper preliminary results of the study are anticipated to give some first insights in the abovementioned topics.

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Day-to-day rural life during the Classical period. The case of Sikyon, Greece

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Abstract

Archaeobotany can become an indispensable component of contextual archaeology only once we acknowledge that its interpretation does not merely amplify the contextual record (Fuller *et al.* 2014). Activities beyond the immediate context that are related to food production or procurement and storage, as well as cooking stages, reflect important daily activities and scheduling decisions, which can be deciphered through the study of archaeobotanical remains. This poster attempts to unfold snapshots of daily life from the Classical-Early Hellenistic period in Greece, specifically at the site of Sikyon (Peloponnese). Both macrobotanical (charred grains) and microbotanical (starch granules) remains are used to decode the agricultural and cooking activities that took place in this site, in the framework of the collaborative 'Old Sikyon Project'. While macrobotanical remains have the potential to shed light on a wide range of human-plant interactions, from resource management and environmental impact to cultural modification of plant products and the plants themselves (Gallacher 2014), starch granules are a source of information concerning plant use and human dietary behavior (Henry 2014). As such, the interdisciplinary nature of the present study not only allows for the tracing of exploited plant resources, relationships between people and plants, and past day-to-day rural life during the Classical-Early Hellenistic periods in NE Peloponnese, but also facilitates suggestions concerning contextual interpretations at the site.

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What's in the pottery? Designing a sampling strategy for the compositional and technological study of Late Chalcolithic pottery from Cyprus

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Abstract

In Late Chalcolithic Cyprus (ca. 2900/2700-2400 BC), pottery production is dominated by red and/or black monochrome wares produced locally across the island, replacing the Red-on-White Ware, popular since the Neolithic (Peltenburg 2007). Additionally, a marked increase in standardization of pottery production is seen in both vessel morphology and composition (Bolger and Webb, 2013, p. 45). Pottery of this time has been studied extensively by several scholars (e.g. Bolger 2007; Paraskeva 2017). However, when it comes to archaeometric techniques, although the Philia wares have been investigated thoroughly (e.g. Dikomitou-Eliadou 2012), Chalcolithic material has been analysed only in a limited extend so far (e.g. Robertson in Bolger 2019). To investigate pottery technologies in the Late Chalcolithic and their degree of variability at a local, regional and inter-regional level, several red and/or black burnished wares from four sites across the island have been selected for their mineralogical, chemical, and microstructural characterisation, involving the use of optical polarising and scanning electron microscopy. These are the Red and Black Stroke-Burnished Ware and Spalled Ware from Chlorakas-Palloures and Kissonerga-Mosphilia; the Red Lustrous Ware and Red Black Lustrous Ware from Ambelikou-Agios Georghios; and Fabric A and Fabric E from Politiko-Kokkinorotsos. As this is an ongoing project, this poster focuses on the sampling strategy, while also presenting the main aims and some preliminary results of the macroscopic analysis of the samples.

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Petrographic analysis of Chalcolithic pottery from Chlorakas-Palloures, Cyprus: A pilot study

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Abstract

Despite the fact that the Chalcolithic in Cyprus is a well-investigated period, hardly any detailed petrographic research on ceramic wares dating to the Middle Chalcolithic and the transitional stage of the Middle/Late Chalcolithic, have been published so far. The Palloures Archaeological Project, led by Dr. Bleda Düring, is an on-going Leiden University excavation at the site of Chlorakas-Palloures, in the Paphos district of Cyprus (www.palloures.eu). Its archaeological significance lies with its chronology, ranging from the early Middle Chalcolithic to the Late Chalcolithic, and with its material connection to key, contemporary sites, such as nearby Lemba-Lakkous and Kissonerga-Mosphilia (Düring *et al.* 2018; Paraskeva 2019). Thin-section petrography is a robust method that has proven useful for classifying, compositionally characterizing, locating provenance and tracing technological choices in ceramic material (Quinn 2013). The author is currently employing this method to study ceramic thin sections that represent each macroscopic group of the three main Middle Chalcolithic ceramic wares from Chlorakas-Palloures, namely the Red-on-White (RW), Plain White (PW) and Red Monochrome (RM) wares (Bolger and Webb, 2013). The main aim of the present study is to contribute to the Palloures ceramic research through a comparison of this preliminary data and the results from the ongoing macroscopic analysis conducted by Paraskeva and Hadjigavriel (Düring *et al.* 2018; Hadjigavriel 2020). Furthermore, the well-preserved stratigraphy and detailed documentation of Chlorakas-Palloures facilitate an analysis of the technological evolution and variability of Middle Chalcolithic wares; more specifically, the potters' technological choices, including: clay recipes, craft traditions and the possibilities of craft specialization and/or standardization. Finally, at a later stage, this work will also contribute to overall research of the Middle Chalcolithic period in Cyprus, by exceeding the regional scale of Chlorakas-Palloures and reaching the sphere of inter-site connections.

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An interdisciplinary study of cooking ware and practices at Toumba Thessaloniki, central Macedonia, from the Late Bronze to the Early Iron Age

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Abstract

Recent archaeological research carried out in central Macedonia over the last decades has provided significant new data for the study of past communities in the Northern Aegean during the transition from the Late Bronze Age (LBA) to the Early Iron Age (EIA). In this framework, our project aims to undertake a diachronic and regional study of cooking pottery from this period in order to shed light on everyday life practices and their reproduction through time and across space. The ultimate objective will be to discuss such data in the context of intense mobility and interaction with other Aegean and Balkan communities in the region, during the so-called Mycenaean period through to the time of the first Greek colonies, that resulted in significant socio-cultural and economic transformations. The project focuses on the detailed morphological, technological and functional, macroscopic, study of cooking pot assemblages from excavated sites in coastal northern Greece, namely Toumba Thessaloniki, dated to late 2nd and early 1st mil. BC. A series of representative samples will be selected for complementary scientific analysis to explore further questions of provenance and technology (through petrographic analysis of thin sections and elemental analysis), as well as function and use (through organic residue and protein analysis, as well as experimentation). The current poster will present the aims and methodology of the project as well as the preliminary results obtained through the macroscopic study and evaluation of existing scientific data.

Understanding Greek Colonisation through material culture: pottery production and consumption in Campania during the 8th and the 7th centuries BC. Project Overview

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Abstract

Studies on material culture in 'colonial' context demonstrated that ceramics when meaningfully constituted and employed as part of social strategies, are informative of social practices relating to the maintenance and reproduction of social groups, power relations and the formation of identities.

This research aims to understand how material culture was employed to promote new social and economic relations during the formative stages of the Greek 'Colonisation' in the Campania region (Italy).

By comparing uniquely combined pottery assemblages dating from the 12th to the 7th centuries BC, this project revisits key sites connected with the phenomenon of Greek 'colonisation' using an innovative and multidisciplinary approach.

An integrated analytical program has been designed to reconstruct and understand reproduction of local pottery traditions through time, as well as mobility of products and transfer of technologies between Campania, Mainland Greece and the broader Mediterranean.

An in-depth macroscopic study of ceramics focusing on the technological and formal characteristics has been combined with science-based analytical techniques to address questions of provenance and technology (thin section petrography, elemental analyses, SEM, ceramic X-Ray). In addition, a program of geological sampling and analysis has been undertaken to record and characterise through the same analytical techniques the locally available raw materials, providing a base for comparison with the ceramic samples. Finally, the use of the Fitch Laboratory (Athens) analytical equipment and protocols on both ceramic and geological samples provided results directly comparable with the lab reference collections (including archaeological pottery and raw materials) from Greek sites with an essential role in the 'colonisation' phenomenon (i.e. Eretria, Chalkida and Corinth).

Container and content: integral analyses of Mediterranean amphorae. Project overview

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Abstract

Pre-modern societies in the Eastern Mediterranean have used amphorae extensively for trading and storage of products such as olive oil, wine, fish, dairy, grains or spices. On the other hand, there is a diversity of shapes, materials, production technology, provenances and functions. This project will search for correlations between characteristics of the amphorae ceramic material and the proteins of the contents preserved within them, with a view to (1) interpret how production, material and shape conditioned their function and content and (2) better understand the effect of different ceramic fabrics in protein preservation and diagenesis. This work will also attempt to shed light on the challenges of protein identification in ceramics (Barker *et al.* 2018), as there have not been many successful and uncontested cases to date (Chowdhury *et al.* 2021; Tanasi *et al.* 2021). The project will compile published data from different studies in the region, as well as analyse new experimental and archaeological samples. The analysis of the ceramic fabrics will be carried out by thin-section petrographic analysis and X-ray diffraction for mineralogical composition and scanning electron microscopy, coupled with energy dispersive X-ray spectroscopy and X-ray fluorescence for elemental analysis. Liquid chromatography in tandem with mass spectrometry will be used to identify the proteins, and therefore contents, preserved either within or on the ceramics. Moreover, protein post-translational modifications (PTM) can be identified, which has been proposed as a way of assessing the preservation state of the proteins (Schroeter and Cleland 2016) and distinguishing ancient endogenous proteins from modern contaminants that can lead to misleading conclusions (Ramsøe *et al.* 2020). Finally, computational proteomics software, Bayesian models and machine learning will be used to analyse and integrate the different kinds of data.

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Architectural Innovation in Cycladic Settlements during Early Bronze Age in the light of the recent excavations at Dhaskalio

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Abstract

The period covering the Final Neolithic to the end of the Early Bronze Age is marked by deep changes perceptible in many fields. The multiplication, extensification and nucleation of settlements is one of the major characteristics of this period and leads, through architectural innovation, to a substantial development of built forms. This innovation is expressed at different scales: in construction techniques, in the spatial configurations and shapes of buildings, and in the spatial organization of settlements, leading to a first form of urbanism. As stated by Amos Rapoport (Rapoport, 1969), without external impulses, built forms do not seem to have a reason to evolve. Even if the partial role of environmental parameters in this transformation should not be overlooked, these innovations mostly illuminate crucial social changes inside Cycladic communities during the Early Bronze Age. The technical and social investment in architecture reaches a whole new scale at the site of Dhaskalio which demonstrates the appearance of a specialized class of people able to conceive and shape such architectural projects as well as the emergence of a new form of authority able to gather, control and manage the means, resources and human labour needed for their construction. This presentation will outline the nature and scale of the changes seen at Dhaskalio and offer some thoughts on their implications for social change in the third millennium.

Geometry of Power: Axis-Nexus through Type-Grafo-Metric Analysis on Mesopotamian Stelae

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Abstract

The “Space of Power” (Deity-Human Kingship Transmission) scene, assembled by a myriad of “Axis-Nexus” (Heaven-World-Underworld) connectors, is recognised by the efforts devoted to its visual representation: material-base (scarcity, hardness and access-mobility), technical-expression (skills-tools) and image-impressed (quality-quantity: size, weight and layout). In this regard, the “King in front of God” Stele, which was largely repeated throughout History under special conditions, in disseminating its “trademark” message, came to reflect a “detailed-calculated” Geometry designed by the Ritual-Code-Archetype tradition of “Power Script” (Order-Equity-Action) and “Symbols” (Ring/Rope-Rod/Sceptre) common in the 4th-1st Millennium BC Cuneiform Area (“Mesopotamia”). “Type-Grafo-Metric” Analysis, verified analogically (free-handed) and digitally (computer-aided), integrates a Grafo-Metry (quantitative) link to a Type-Meaning (qualitative) interpretation. Applied to a Mesopotamian corpus of stelae (3 stelae x 3 millennia), which were selected according to specific visual properties (9 out of 121 considered), this Analysis creates a path for navigating the “Geometry of Power”. The analytical technique, itself, involves drawing graphical elements (points, lines and figures) on the images to establish geometric relations between them using the symbolic meaning attributed to its whole composition and certain geometric elements derived from the context. Once all the stelae are analysed and their “Axis-Nexus” detected (“Particular” specimen output), they are compared to each other in order to look for common elements that conform to predictive models for each millennium (“Pattern”) and for the Mesopotamian region as a whole (“Paradigm”). “Type-Grafo-Metric” Analysis has proven especially useful in providing a sound methodological solution to the outstanding academic issue of “reconstructing” the upper and lower sides of the Victory Stele of Naram-Sin. This study further enriches knowledge of the “Structure of the Space of Power” imagery ordered by “Axis-Nexus,” on particular stelae according to their specific Pattern-Millennium. Implementing an innovative point of view, a combined geometric quantitative-qualitative interpretation provides new information, verifies and validates existing models, and connects distant mental-spatial-temporal coordinates, leading towards a “Geometry of Power” paradigm that was established of the course of several millennia during the Mesopotamian Cuneiform “Horizon”.

A biography of a traditional rural house from Ayios Amvrosios: Tree-ring research opportunities in a rural landscape

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Abstract

The slopes of the Kyrenia mountain range in Cyprus have a unique cultural ecosystem that is nourished by localized hubs located along this range. As one of these hubs, Ayios Amvrosios is situated on the north slopes of the range close to the forested Halevka area. A pastoral lifestyle is the predominant way of life in Ayios Amvrosios and its surroundings, as seen throughout Kyrenia's rural mountain landscape. However, current scholarly work fails to recognize this pastoral lifestyle and the human-environment interaction that effectively shapes the region's cultural landscape in a temporal context. On the other hand, the dwindling number of traditional village houses still provides an opportunity to better understand the villages' pastoral activities and historical backgrounds with the help of dendrochronological investigation, along with observations on architectural history. Traditional rural houses in the Kyrenia range were constructed with local materials, including earth, wood, and rock, according to the regional needs and climate conditions. With a switch to concrete construction methods in the mid-20th century, traditional houses were mostly abandoned. This situation specifically threatens the possible data that can be extracted from wooden construction materials, since timbers from derelict houses are often used as a fuel. Therefore, finding old houses from which to extract tree-ring data is rather challenging and entails a rescue operation. Preliminary research conducted at one of the abandoned rural houses from Ayios Amvrosios illustrates the potential in studying these traditional dwellings from a dendrochronological perspective as a means of investigating the cultural and natural landscape of the Kyrenia mountain complex.

Application of computed tomography for the characterization of historical footwear

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Abstract

This poster discusses the application of Computed Tomography (CT) for the characterization of a pair of female *slippers* (slip-on footwear) from Chios Island in Greece. They are dated to the early 20th century and belong to the collection of the Lyceum Club of Greek Women in Athens. The aim of the research was to determine the manufacturing technology and the composition of construction materials, as well as to assess their condition and devise an appropriate treatment methodology (Douglas *et al.* 2018; Jervis *et al.* 2010). The slippers are flat with pointed, upturned toes and have a textile vamp (the top part of the shoe from toe to instep) and leather outsole (Veres 2005). A purple velvet fabric with metal thread embroidery was used both as vamp and for the insole. The conservation treatment of footwear can be challenging for different reasons: they are small, three-dimensional objects that are not always easy to manipulate during treatment; and they consist of a variety of materials which can be invisible and inaccessible. Furthermore, since footwear from that period is not commonly represented in Greek collections, their detailed study is crucial to providing both technological knowledge and evidence about the value and significance of such objects. The analytical protocol included classical methods for the study of composite textile objects (OM, SEM/EDX, X-radiography and FTIR). All of these techniques provided answers to the research questions; however, the results from the X-radiography of the layers comprising the sole were not conclusive, due to the different absorption the construction materials present in x-rays. This prompted its further investigation through CT scan (Morigi *et al.* 2010; O'Connor *et al.* 2007). With the successive small sections of the object generated by CT, both horizontally and vertically, internal deformations of the construction materials were recognized, explaining the shape of the *slippers*. The stitching direction and the space between stitches in the various parts were also recorded. Furthermore, it was possible to identify the successive layers of the sole (leather and supporting materials); the variation in gray tones of the inner layers suggests the presence of eight (8) different materials. Finally, information concerning the condition of the internal layers was obtained, providing details about their use and about the wearer (Rublack 2013).

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