

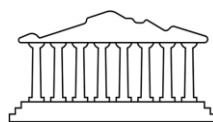
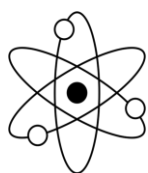
ΕΛΛΗΝΙΚΗ ΑΡΧΑΙΟΜΕΤΡΙΚΗ ΕΤΑΙΡΕΙΑ

HELLENIC SOCIETY FOR ARCHAEOMETRY



ΒΙΒΛΙΟ ΠΕΡΙΛΗΨΕΩΝ

BOOK OF ABSTRACTS



ΕΠΙΜΕΛΕΙΑ: Γ. ΦΑΚΟΡΕΛΛΗΣ

Οργανωτική Επιτροπή

Δρ Μ. Καπαρού, ΕΚΕΦΕ 'Δημόκριτος'
Δρ Α. Οικονόμου, ΕΚΕΦΕ 'Δημόκριτος'
Δρ Ε. Κουλουμπή, Εθνική Πινακοθήκη
Δρ Μ. Παπαγεωργίου, The American College of Greece
Δρ Ι. Μπασιάκος, ΕΚΕΦΕ 'Δημόκριτος'
Καθ. Γ. Φακορέλλης, Πανεπιστήμιο Δυτικής Αττικής
Δρ Ε. Φιλιππάκη, ΕΚΕΦΕ 'Δημόκριτος'

Επιστημονική Επιτροπή

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Prof. J. Henderson (Nottingham University)
Prof. Marcos Martín-Torres (University of Cambridge)
Dr E. Photos-Jones (Scottish Analytical SAA)
Prof. Th. Rehren (The Cyprus Institute)
Prof. K. Sporn (German Archaeological Institute)
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Καθ. Απ. Σαρρής (Πανεπιστήμιο Κύπρου)
Καθ. Γρ. Τσόκας (Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκη)

ΧΟΡΗΓΟΙ - ΥΠΟΣΤΗΡΙΚΤΕΣ



ΒΥΖΑΝΤΙΝΟ & ΧΡΙΣΤΙΑΝΙΚΟ ΜΟΥΣΕΙΟ
Υπουργείο Πολιτισμού και Αθλητισμού



ΕΘΝΙΚΟ ΚΕΝΤΡΟ ΕΡΕΥΝΑΣ ΦΥΣΙΚΩΝ
ΕΠΙΣΤΗΜΩΝ «ΔΗΜΟΚΡΙΤΟΣ»



ΑΝΑΛΥΤΙΚΕΣ ΣΥΣΚΕΥΕΣ Α.Ε.
Δρ Κ.Ι. ΒΑΜΒΑΚΑΣ - ΕΠΙΣΤΗΜΟΝΙΚΟΣ ΕΞΟΠΛΙΣΜΟΣ



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ΠΡΟΛΟΓΟΣ

Αγαπητοί/ές Συνάδελφοι,

Σας καλωσορίζουμε στις εργασίες του 8^{ου} Συμποσίου Αρχαιομετρίας της Ελληνικής Αρχαιομετρικής Εταιρείας (ΕΑΕ), που πραγματοποιείται από την Τρίτη, 17 Οκτωβρίου ως την Παρασκευή, 20 Οκτωβρίου 2023 στους χώρους του Βυζαντινού και Χριστιανικού Μουσείου, κατόπιν ευγενούς χορηγίας του Διοικητικού Συμβουλίου του.

Το Συμπόσιο αποτελεί συνέχεια των επτά (7) προηγούμενων αντίστοιχων διοργανώσεων που έχει πραγματοποιήσει με επιτυχία η ΕΑΕ στο παρελθόν. Έχει τίτλο **«Αρχαιομετρία πέρα από την ανάλυση: Ερμηνευτικές Προσεγγίσεις»** και ως επίκεντρο την Πολιτιστική Κληρονομιά του ελλαδικού χώρου, των Βαλκανίων και της αν. Μεσογείου. Στοχεύει να αναδείξει τα αποτελέσματα των τρεχουσών ερευνών και να αποτελέσει έναυσμα για την αποτίμηση μεθοδολογιών, πρακτικών και εμπειριών, στην επίλυση μακροχρόνιων προβλημάτων και στην αναζήτηση μελλοντικών προοπτικών και τάσεων.

Οι εργασίες που παρουσιάζονται στο πλαίσιο του 8^{ου} Συμποσίου κατανέμονται στις εξής θεματικές ενότητες:

- α. Λίθοι, Χρωστικές και Κονιάματα**
- β. Ανόργανα Υλικά (Κεραμικά, Μέταλλα, Γαλώδεις Ύλες)**
- γ. Βιοϋλικά και Οργανικά κατάλοιπα**
- δ. Θετικές Επιστήμες στην Επιστήμη της Συντήρησης**
- ε. Νέες και εδραιωμένες εφαρμογές στην Αρχαιομετρία**

Στις εργασίες του Συμποσίου πρόκειται να ανακοινωθούν πρωτότυπες επιστημονικές εργασίες, υπογραφόμενες από Έλληνες και ξένους ειδικούς, που αναφέρονται σε σημαντικά ερευνητικά ζητήματα της Ελλάδος και της ευρύτερης περιοχής και καλύπτονται με μεγάλη επιτυχία όλα, σχεδόν, τα θεματικά πεδία των σύγχρονων αρχαιομετρικών μελετών. Επισημαίνεται, ακόμη, η ειδική σπουδαιότητα της από κοινού συνεισφοράς Αρχαιολόγων και ειδικών από τις Θετικές Επιστήμες σε πολλές εργασίες, καθώς και το υψηλό ποσοστό παρουσίας νέων επιστημόνων με προφορικές ανακοινώσεις ή με μορφή αφίσας.

Επιπροσθέτως, σε αυτό το Συμπόσιο εγκαινιάζεται το Βραβείο Νέου/ας Ερευνητή/ιας **«Μυρτώ Γεωργακοπούλου»**, στη μνήμη της αγαπημένης φίλης και συναδέλφου που μας άφησε τόσο πρόωρα.

Την Επιστημονική Επιτροπή απαρτίζουν κορυφαίοι ερευνητές και ερευνήτριες, των οποίων η συνεισφορά στο χώρο της Αρχαιομετρίας και της Πολιτιστικής Κληρονομιάς έχει ευρέως αναγνωρισθεί. Η συνεισφορά τους ήταν, ήδη, καίρια στην αξιολόγηση των υποβληθεισών περιλήψεων και αναμένεται να είναι εξίσου ουσιαστική στην επιστημονική κρίση των εργασιών που θα υποβληθούν προς δημοσίευση στα Πρακτικά του Συμποσίου. Υπενθυμίζεται ότι τα Πρακτικά του Συμποσίου θα δημοσιευτούν στο περιοδικό AURA, το οποίο είναι ένα διεθνές επιστημονικό περιοδικό με σύστημα διπλής ανώνυμης αξιολόγησης που εκδίδεται ετησίως από το Τμήμα Ιστορίας και Αρχαιολογίας του Εθνικού και Καποδιστριακού Πανεπιστημίου Αθηνών.

Θα θέλαμε επίσης να ευχαριστήσουμε τους εκλεκτούς συναδέλφους που αποδέχτηκαν την πρόσκληση του Διοικητικού Συμβουλίου της ΕΑΕ να συμμετέχουν με προσκεκλημένες ομιλίες, οι οποίες καλύπτουν ένα ευρύ φάσμα δραστηριοτήτων στο χώρο της Πολιτιστικής Κληρονομιάς.

Σας ευχαριστούμε όλους και όλες θερμά για τη στήριξη και συμμετοχή σας στο 8^ο Συμπόσιο της ΕΑΕ, το οποίο ευελπιστούμε ότι θα είναι αντάξιο της λαμπρής παράδοσης των προηγούμενων αντίστοιχων.

Με εκτίμηση,

Η Οργανωτική Επιτροπή - Το Διοικητικό Συμβούλιο της ΕΑΕ

INTRODUCTION

Dear Colleagues,

We welcome you to the 8th Symposium of Archaeometry by the Hellenic Society for Archaeometry (HSA), which takes place on Tuesday, October 17- Friday, October 20, 2023 at the premises of the Byzantine and Christian Museum with the kind support of its Board.

The Symposium succeeds the seven (7) previous symposia successfully held by HSA in the past. It is entitled **"Archaeometry beyond analysis: Interpretive Approaches"** and focuses on the Cultural Heritage of Greece, the Balkans and Eastern Mediterranean. It aims to highlight the results of current research and serve as a springboard for the evaluation of methodologies, practices and experience, in resolving ongoing issues and in the search for future perspectives and trends.

The papers presented in the context of the 8th Symposium are divided into the following thematic sections:

- a. **Stones, Pigments and Mortars**
- b. **Inorganic Materials (Ceramics, Metals, Vitreous Materials)**
- c. **Biomaterials and Organic residues**
- d. **Conservation Science**
- e. **New and established applications in Archaeometry**

In the proceedings of the Symposium, original scientific papers by Greek and foreign experts, related to important research issues of Greece and the wider region and covering almost all the thematic fields of modern Archaeometry studies, are to be presented. The joint contribution of archaeologists and experts from the Physical Sciences in many studies, as well as the high percentage of participation of young scientists with oral or poster presentations should be highlighted.

In addition, the **"Myrto Georgakopoulou"** Young Researcher Award is inaugurated in this Symposium, in memory of the beloved friend and colleague who left us so early.

The Scientific Committee is comprised of leading researchers, whose contribution to the field of Archaeometry and Cultural Heritage has been widely recognized. Their aid has already been crucial in the evaluation of the submitted abstracts and is expected to be equally essential in the review of the papers to be submitted for publication in the Proceedings of the Symposium. We kindly remind you that the Proceedings of the Symposium will be published in AURA, which is an international scientific journal following peer review system and is published by the Department of History and Archeology of the National and Kapodistrian University of Athens on an annual basis.

We would also like to thank the distinguished colleagues who accepted the invitation of the HSA Board to deliver invited talks, covering a wide range of research in the field of Cultural Heritage.

We sincerely thank you all for your support and participation in the 8th Symposium by HSA, which we are hopeful that it will be worthy of its brilliant tradition.

With our best wishes,

The Organizing Committee - The HSA Board



ΠΡΟΓΡΑΜΜΑ / PROGRAM

HELLENIC SOCIETY FOR ARCHAEOMETRY

ΠΡΟΦΟΡΙΚΕΣ ΑΝΑΚΟΙΝΩΣΕΙΣ / ORAL PRESENTATIONS

Τρίτη, 17 Οκτωβρίου 2023 / Tuesday, 17 October 2023

08:00-09:00	Προσέλευση Συνέδρων, Εγγραφές / Registration
09:00-09:30	Τελετή έναρξης και χαιρετισμοί / Opening Ceremony and welcoming remarks
09:30-11:30	<i>Λίθοι-Χρωστικές-Κονιάματα / Session: Lithics-Pigments-Mortars</i> <i>Προεδρείο / Chairs: Πομώνης Π. Μέξη Μ.</i>
09:30-10:00	ΠΡΟΣΚΕΚΛΗΜΕΝΗ ΟΜΙΛΙΑ / INVITED LECTURE Η τοιχογραφία με το κυνήγι από τον Τάφο του Φιλίππου Β' στις Αιγές: Μια νέα διεπιστημονική προσέγγιση με μη-επεμβατικές τεχνικές στα πλαίσια του ερευνητικού έργου ReVis <i>Χαρίκλεια Μπρεκουλάκη</i>
10:00-10:20	Μελέτη φυσικών και συνθετικών χρωστικών ultramarine με φυσικοχημικές μεθόδους <i>Πουρλιάκα Α., Μαλλετζίδου Λ., Ζορμπά Τ., Παρασκευόπουλος Κ., Παυλίδου Ε., Βουρλιάς Γ.</i>
10:20-10:40	Διερευνώντας την πολυχρωμία των αρχιτεκτονικών μελών του Πεισιστράτειου Τελεστηρίου στο Ιερό της Δήμητρας και Κόρης στην Ελευσίνα <i>Φραντζή Γ., Μπρεκουλάκη Χ., Καρύδας Α., Θεουλάκης Π., Μπογιατζής Σ., Μαστροθεόδωρος Γ., Ε. Παπαθωμά</i>
10:40-11:00	The effects of fire on wall paintings: In-situ following the thermal degradation of painting binders with a DRIFT environmental chamber <i>Malletzidou L.</i>
11:00-11:20	Διαγνωστικό πρωτόκολλο τέχνηργων στο Εργαστήριο Συντήρησης Γλυπτών του Εθνικού Αρχαιολογικού Μουσείου: Ένα μεθοδολογικό στάδιο στο πλαίσιο των εργασιών συντήρησης <i>Παναγάκος Ι., Τσακρή Κ.</i>
11:20-11:40	Πετρογραφική μελέτη εμφανίσεων οφίτη (σερπεντινίτη) στην Κρήτη. Αναζήτηση προέλευσης της πρώτης ύλης ευρημάτων της Ζάκρου <i>Παπαδοπούλου Δ., Πομώνης Π.</i>
11:40-12:00	Διάλειμμα καφέ / Coffee break
12:00-14:00	<i>Λίθοι-Χρωστικές-Κονιάματα / Lithics-Pigments-Mortars</i> <i>Προεδρείο / Chairs: Μπρεκουλάκη Χ., Λάσκαρης Ν.</i>



- 12:00-12:20** Ο ρόλος των λίθινων πρώτων υλών στη κατασκευή μακρολιθικών εργαλείων της Πρώιμης Εποχής του Χαλκού στο Κορωπί Αττικής: Πετρογραφικά χαρακτηριστικά και πιθανή προέλευση
Μέξη Μ., Πομώνης Π.
- 12:20-12:40** Ελαφροβαρή επιχρίσματα για αποκαταστάσεις ιστορικών κατασκευών
Λουκμά Μ., Καμπράγκου Π., Στεφανίδου Μ.
- 12:40-13:00** An archaeometric study of hydraulic plasters from the Roman public baths of Kourion, Cyprus
Kalofonou M., Ioannou I., Kassianidou V.
- 13:00-13:20** Archaeometric investigation of post-Byzantine icons by means of macroscopic XRF
Mastrotheodoros G.P., Asvestas A., Gerodimos Th., Chatzipadeliadis D., Agrafioti K., Tzima A., Anagnostopoulos D.F.
- 13:20-13:40** Διάγνωση και ερμηνεία μιας επιζωγραφισμένης εικόνας μέσω αναλυτικών τεχνικών: Η περίπτωση της εικόνας «Παναγία με αγίους» (Nr.In.3622)
Marolli F., Λαζίδου Δ.
- 13:40-14:00** A comprehensive review and meta-analysis of compositional analyses of archaeological obsidian tools and evaluation of the discrimination of the Greek obsidian sources
Drakoulakou E., Tsoutsoumanos E., Ntougla M., Polymeris G.S., Ganetsos Th., Laskaris N.
- 14:00-15:00** Ελαφρύ γεύμα / Light lunch
1^η Συνεδρία Αναρτημένων Ανακοινώσεων / 1st Poster Session
- 15:00-17:00** *Νέες και εδραιωμένες εφαρμογές στην Αρχαιομετρία / New and established applications in Archaeometry*
Προεδρείο / Chairs: Μπασιάκος Ι., Τσόκας Γ.
- 15:00-15:20** Ανασκόπηση της διακύμανσης του φαινομένου της θαλάσσιας δεξαμενής στο Αιγαίο Πέλαγος κατά τα τελευταία 13.000 χρόνια cal BP και οι επιπτώσεις της στη χρονολόγηση με 14C
Φακορέλλης Γ.
- 15:20-15:40** Innovations in imaging of the subsurface of archaeological sites and the interior of structural elements of monuments in 3 and 4 dimensions developed in the framework of the EKATY project
Tsokas G.N.
- 15:40-16:00** A modular custom-built Macro-XRF spectrometer for Heritage Science
Tsampa K., Androurakaki E., Assiouras P., Wrobel P., Karydas A.G.
- 16:00-16:20** Study and documentation of Late Bronze Age (LH IIIA1 period) pottery from “Vagia”, Kalapodi east Locris Greece: The use of 3D scanning technology and 3D color printing
Papageorgiou M.I., Brachos K., Ganetsos Th., Kantaros A., Mouzakiotou S., Soulis V.



16:20-16:40	Reevaluation of mathematical and tunnelling aspects of the Eupalinos' aqueduct <i>Chiotis E.</i>
16:40-17:00	An astronomical precise dating of Odysseus' return to Ithaca <i>Papamarinopoulos S.P.</i>
17:00-17:30	Διάλειμμα καφέ / Coffee break
17:30-18:30	KΕΝΤΡΙΚΗ ΟΜΙΛΙΑ / KEYNOTE LECTURE Advanced X-ray based methodologies for the non-invasive investigation of tangible Cultural Heritage <i>Francesco Paolo Romano</i>
18:30-18:40	Παρουσίαση του European Conference on X-Ray Spectrometry EXRS24 <i>Καρύδας Α.</i>
18:40-21:30	Δεξίωση Υποδοχής / Welcome reception Βυζαντινό και Χριστιανικό Μουσείο / Byzantine and Christian Museum

Τετάρτη, 18 Οκτωβρίου 2023 / Wednesday, 18 October 2023

08:30-09:30	Εγγραφές / Registration
09:30-11:30	Ανόργανα υλικά - Κεραμικά και υαλώδεις ύλες / Inorganic materials - Ceramics and vitreous materials <i>Προεδρείο / Chairs: Καρύδας Α., Ζαχαριάς Ν.</i>
09:30-10:00	ΠΡΟΣΚΕΚΛΗΜΕΝΗ ΟΜΙΛΙΑ / INVITED LECTURE Recent and advanced data from pyrometallurgical studies <i>Νικόλαος Ζαχαριάς</i>
10:00-10:20	Unlocking the secrets of glass bangles from Ierissos, Chalkidiki: Technological insights and provenance through SEM-EDS analysis <i>Oikonomou A., Tsanana A., Amprazogoula K., Rehren Th.</i>
10:20-10:40	Mycenaean vitreous artifacts: Overcoming taxonomy hurdles via analysis <i>Kaparou M., Oikonomou A., Nikolentzos K., Anagnostopoulos D.F., Karydas A.G.</i>
10:40-11:00	Μικροσκοπικές παρατηρήσεις στην κεραμική του νεολιθικού οικισμού του Δισπηλιού Καστοριάς <i>Σαριδάκη Ν., Χριστοδούλου Κ., Hein A., Κυλίκογλου Β., Κωτσάκης Κ.</i>
11:00-11:20	Archaeometric analysis of modern pottery from Kentri (Ierapetra, Crete) and its implications for the study of ancient ceramics: Tthe case of the Minoan granodioritic pottery in the Isthmus of Ierapetra <i>Koutounaki E., Nodarou E., Pomonis P., Papadatos Y.</i>
11:20-12:00	Διάλειμμα καφέ / Coffee break



- 12:00-14:00** *Ανόργανα υλικά - Κεραμικά και υαλώδεις ύλες / Inorganic materials - Ceramics and vitreous materials*
Προεδρείο / Chairs: Κυριατζή Ε., Νοδάρου Ε.
- 12:00-12:20** **Reaching the peak: Archaeometric analysis of pottery from the peak sanctuary of Philioremos-Gonies (north-central Crete)**
Nodarou E., Kyriakidis E.
- 12:20-12:40** **Ceramic production and exchange networks in Middle Bronze Age Attica**
Balitsari A.
- 12:40-13:00** **Η εξέλιξη της χονδροειδούς κεραμικής στο ιερό του Καλαποδίου από τα τέλη της Μυκηναϊκής Εποχής έως την Πρώιμη Εποχή του Σιδήρου: Αρχαιομετρικές προσεγγίσεις**
Χριστοδούλου Κ., Hein A.
- 13:00-13:20** **Delos and its regional networks in the Hellenistic period**
Marzec E.
- 13:20-15:00** **Ελαφρύ γεύμα / Light lunch**
2^η Συνεδρία Αναρτημένων Ανακοινώσεων / 2nd Poster Session
- 15:00-16:00** *Ανόργανα υλικά - Κεραμικά και υαλώδεις ύλες / Inorganic materials - Ceramics and vitreous materials*
Προεδρείο / Chairs: Κιλίκογλου Β., Παπαδάτος Γ.
- 15:00-15:20** **Machine learning approaches in the interpretation of compositional data of archaeological ceramics collected with pXRF**
Hein A., Kilikoglou V.
- 15:20-15:40** **Colors on fire: Reconstructing the change of color hues in firing of experimental ceramic briquettes**
Xanthopoulou V. Karountzou G., Iliopoulos I.
- 15:40-16:00** **Preliminary study of Lesvos clayey raw materials: A pXRF analysis**
Pollatou A.-M., Hein A., Kiriati E., Iliopoulos I.
- 16:00-16:30** **Διάλειμμα καφέ / Coffee break**
- 16:30-18:30** *Γέφυρες Αρχαιομετρίας / Bridging Archaeometry*
- 16:30-16:40** **Εργαστήριο Αρχαιολογικών και Δομικών Υλικών, Ινστιτούτο Νανοεπιστήμης και Νανοτεχνολογίας, Ε.Κ.Ε.Φ.Ε. 'Δημόκριτος'**
Καρατάσιος Ι.



16:40-16:50	Laboratory of Exploration Geophysics <i>Τσόκας Γρ.</i>
16:50-17:00	Εργαστήριο μελέτης και συντήρησης αρχαίων και νεώτερων πολιτιστικών αγαθών, Πανεπιστήμιο Δυτικής Αττικής <i>Μπογιατζής Σ.</i>
17:00-17:10	The Marc and Ismene Fitch Laboratory for Archaeological Science, British School at Athens <i>Κυριατζή Ε., Müller N.</i>
17:10-17:20	The Malcolm H. Wiener Laboratory for Archaeological Science <i>Μιχαηλίδης Δ.</i>
17:20-17:30	Ινστιτούτο Μελέτης Προϊστορικού Αιγαίου Ανατολικής Κρήτης (INSTAP Study Center for East Crete) <i>Νοδάρου Ε., Hall K.</i>
17:30-17:40	Τμήματα Φυσικής, Γεωλογίας και Πολιτικών Μηχανικών, Αριστοτέλειο Πανεπιστήμιο Θεσσαλονίκης <i>Στεφανίδου Μ.</i>
17:40-17:50	Εργαστήριο Φυσικής Ανθρωπολογίας, Δημοκρίτειο Πανεπιστήμιο Θράκης <i>Παπαγεωργοπούλου Χρ.</i>
17:50-18:00	Ερευνητική ομάδα Κέραμος, Εργαστήριο Έρευνας Ορυκτών και Πετρωμάτων, Πανεπιστήμιο Πατρών <i>Ξανθοπούλου Β.</i>
18:00-19:00	Στρογγυλή τράπεζα / Round table

Πέμπτη, 19 Οκτωβρίου 2023 / Thursday, 19 October 2023

08:30-09:00	Εγγραφές / Registration
09:00-11:20	Ανόργανα υλικά – Μέταλλα / Inorganic materials – Metals <i>Προεδρείο / Chairs: Χιώτης Ε., Νεραντζής Ν.</i>
09:00-09:20	Χημική ανάλυση χάλκινων αντικειμένων της Πρώιμης και Μέσης Εποχής του Χαλκού από τη βόρεια ακτή της Κύπρου <i>Χαραλάμπους Α., Webb J.M., Κασσιανίδου Β., Παπασάββας Γ.</i>
09:20-09:40	The “lost city of copper”? Copper production at Enkomi: A study of metallurgical ceramics <i>Ioannides D., Kassianidou V., Papasavvas G.</i>
09:40-10:00	Accidental or intentional? The practice of Early Copper-alloying with arsenic in the Aegean <i>Bassiakos Y., Filippaki E., Nikolopoulou A.</i>



- 10:00-10:20** **Assessment of erosion risk for metallurgical slags on Agios Sostis peninsula, Siphnos island**
Tsakalos E., Kazantzaki M., Filippaki E., Bassiakos Y.
- 10:20-10:40** **New data on the metallurgical production on western Siphnos**
Zogkos G., Giannakopoulou M., Papadopoulou Z., Vlachopoulos A.
- 10:40-11:00** **Early Bronze Age silver production on southern Sifnos: the sites of Kasela and Akrotiraki**
Giannakopoulou M.
- 11:00-11:20** **Το μυκηναϊκό σύστημα ta-ra-si-ja και η συμβολή των αρχαιομετρικών αναλύσεων στην κατανόησή του**
Χρήστου Σ., Πετράκης Β., Παπαδάτος Γ.
- 11:20-12:00** **Διάλειμμα καφέ / Coffee break**
- 12:00-14:20** ***Ανόργανα υλικά - Μέταλλα / Inorganic materials - Metals***
Προεδρείο / Chairs: Χαραλάμπους Α., Βαξεβανόπουλος Μ.
- 12:00-12:20** **New data on the mining process at Lavrion**
Vaxevanopoulos M., Ross J., Albaréde F., Davis G., Voudouris P., Melfos V., Blichert-Toft J.
- 12:20-12:40** **Preliminary pXRF analysis on silver coins from ancient cities of Aegean Thrace**
Nerantzis N., Tasaklaki M.
- 12:40-13:00** **The numismatic heritage of Rhodes: Insights from microscopic X-ray fluorescence (μ-XRF) analyses of copper and silver alloy coins from the 4th century BCE to the 2nd century CE**
Kladouri N.K., Skaltsa S., Gerodimos Th., Pezouvani K., Karydas A.G.
- 13:00-13:20** **Ancient iron objects from the Sanctuary of Zeus Parnessios. Smithing the archaeometallurgical information**
Roggenbucke M., Filippaki E.
- 13:20-13:40** **Late Bronze Age gold artefacts from Kalapodi, Phthiotis, Central Greece: Preliminary results**
Staikou M.C., Filippaki E., Dimaki S.
- 13:40-14:00** **Epitaphioi from Vatopediou Monastery at Mount Athos and the Ecumenical Patriarchate of Constantinople: Advancements in manufacturing technology or just luxurious?**
Karydis C., Panagopoulou A.P., Alipranti Fl.
- 14:20-15:30** **Ελαφρύ γεύμα / Light lunch**
3^η Συνεδρία Αναρτημένων Ανακοινώσεων / 3rd Poster Session


15:30-17:30 Βιοϋλικά και οργανικά κατάλοιπα / Biomaterials and organic residues

Προεδρείο / Chairs: Μουτάφη Ι., Ρούμπου Μ.

15:30-16:00 ΠΡΟΣΚΕΚΛΗΜΕΝΗ ΟΜΙΛΙΑ / INVITED LECTURE

Εφαρμογές αναλυτικών και ψηφιακών μεθόδων στη μελέτη και προβολή ανθρωπολογικού υλικού

Χριστίνα Παπαγεωργοπούλου

16:00-16:20 METAMOBILITY: Meta-analysis and agent-based modeling of human mobility in the Graeco-Roman world

Nikita E.

16:20-16:40 A spatiotemporal study of population continuity and discontinuity in central Greece during Classical and Hellenistic times through biodistance analysis

Karligkioti A., Aravantinos V., Charami A., Nikita E.

16:40-17:00 Exploring ancient infant weaning: Leveraging machine learning and Bayesian Modelling on stable isotope data from dentinal collagen

Ganiatsou E., Souleles A., Papageorgopoulou Ch.

17:00-17:20 Echoes, an interdisciplinary reconstruction of life in ancient Thessaloniki

Aidonis A., Ganiatsou E., Souleles A., Korelidou M., Bantavanou P., Georgiou G., Kompatsiaris I., Protopsalti S., Tzevreni S., Mitsopoulou E., Alagiologlou C., Mavrokostidou M., Kartsiakli V., Vraha C.P., Papageorgopoulou Ch.

20:30 Δείπνο Συμποσίου / Symposium dinner

Παρασκευή, 20 Οκτωβρίου 2023 / Friday, 20 October 2023

08:30-09:30 Εγγραφές / Registration
09:30-11:30 Βιοϋλικά και οργανικά κατάλοιπα / Biomaterials and organic residues

Προεδρείο / Chairs: Παπαγεωργοπούλου Χρ., Παπαθανασίου Α.

09:30-09:50 Urban bioarchaeology of Thessaloniki. A biosocial analysis of the skeletal material excavated during the construction of the metropolitan subway

Aidonis A., Ganiatsou E., Souleles A., Korelidou M., Bantavanou P., Protopsalti S., Tzevreni S., Vasileiadou S., Konstantinidou K., Papageorgopoulou Ch.

09:50-10:10 Investigating food practices and cultural hybridity in the ancient Greek colony, Ambracia using Stable isotopes ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) and Bayesian Mixing model

Georgiadou A., Ganiatsou E., Xanthopoulos K., Papageorgopoulou Ch.

10:10-10:30 Investigation of spectral markers appropriate for optimized archaeogenetic analysis of ancient teeth and bones based on Raman scattering and fluorescence spectroscopy techniques

Philippidis A., Mamali A., Psonis N., Vassou D., Tabakaki E., Nafplioti A., Poulakakis N., Anglos D.



10:30-10:50	Developing a multi-analytical methodology for the detection and characterization of organic residues in archaeological findings using molecular spectroscopic techniques <i>Konstantinou M.E., Roumpou M., Philippidis A., Sotiropoulou S., Anglos D.</i>
10:50-11:10	Foodways and pottery production and use in the Indus Valley Civilization: Application of spectroscopic and spectrometric techniques <i>Sarkar S., Boyatzis S., Roumpou M., Kalogeropoulos N., Zacharias N.</i>
11:30-12:00	Διάλειμμα καφέ
12:00-14:00	Βιοϋλικά και οργανικά κατάλοιπα / Biomaterials and organic residues <i>Προεδρείο / Chairs: Photos-Jones E., Φακορέλλης Γ.</i>
12:00-12:20	Doing biotech on a ...seasonal basis: the making of <i>psimythion</i> (5th-3rd c. BCE) <i>Kallithraka S., Knapp C.W., Photos-Jones E.</i>
12:20-12:40	The contribution of residue analysis in the interpretation of prehistoric quartz chipped stone tools <i>Palli O., Pavlidou E., Malletzidou L., Zorba T., Nazlis I., Trantalidou K., Darlas A., Pappa M., Kotsakis K., Andreou S., Triantafyllou S., Kourtessi-Philippakis G.</i>
12:40-13:00	Modern techniques on extremely old fossils: the case of conodonts <i>Georgopoulos C., Stathopoulou E., Kranis H., Zambetaki-Lekkas A.</i>
13:00-13:20	Bioerosional tunneling in the dentine of the pygmy Hippos of Cyprus <i>Noulis V., Stathopoulou E., Theodorou G.</i>
13:20-13:40	Κτερίσματα και προσφορές από οργανικά υλικά στο νεκροταφείο του Δέλτα Φαλήρου <i>Παναγοπούλου Α., Παππάς Ι., Μπογιατζής Σ., Ζαχαριάς Ν.</i>
13:40-15:00	Ελαφρύ γεύμα / Light lunch 4^η Συνεδρία Αναρτημένων Ανακοινώσεων / 4th Poster Session
15:00-16:30	Θετικές Επιστήμες στη Συντήρηση / Conservation Science <i>Προεδρείο / Chairs: Μπογιατζής Α., Χλουβεράκη Σ.</i>
15:00-15:30	ΠΡΟΣΚΕΚΛΗΜΕΝΗ ΟΜΙΛΙΑ / INVITED LECTURE Επίκαιρα ζητήματα της σύγχρονης θεωρίας της συντήρησης <i>Μαρία Μερτζάνη</i>
15:30-15:50	Non Destructive Testing (NDT) methods for the evaluation of new green materials for artwork conservation <i>Alexopoulou A.G., Kaminari A.A., Choulis K., Theochari S., Banou P., Kiskira E., Panou E., Mastrotheodoros G., Karabotsos A.</i>
15:50-16:10	Integrated research for the characterization of the construction technique of mural paintings from two different sites of the Vatopedi Monastery (Mount Athos, Greece) <i>Kouloumpi E., Oikonomou A., Terlix A.-V., Andrianakis M., Tornari V., Papaioannou E., Karydis C., Vandenabeele P., Rousaki A.</i>



- 16:10-16:30** **Διαγνωστικές τεχνικές σε πήλινα πολύχρωμα ειδώλια κλασικής και ελληνιστικής περιόδου από την Χαλκίδα**
Καραμουζάς Δ., Παναγάκος Ι., Τσακρή Π., Χιδίρογλου Μ., Μπογιατζής Στ.
- 16:30-17:00** **Τελικά Σχόλια, Βραβεία ‘Μυρτώ Γεωργακοπούλου’ Λήξη Συμποσίου / Closing remarks, ‘Myrto Georgakopoulou’ awards**
Ακολουθεί καφές με συζήτηση / Coffee break with discussion

**ANAPHTHMEΝΕΣ ΑΝΑΚΟΙΝΩΣΕΙΣ / POSTER PRESENTATIONS****Τρίτη, 17 Οκτωβρίου 2023 / Tuesday, 17 October 2023****1^η Συνεδρία Αναρτημένων Ανακοινώσεων 14:00-15:30 / 1st Poster Session 14:00-15:30****Λίθοι-Χρωστικές-Κονιάματα / Lithics-Pigments-Mortars**

Νάκου Σ., Γκανέτσος Θ., Κατσαντώνη Μ., Αλεξανδράκης Θ., Δούρος Π. | *Το έργο του ζωγράφου Αγοραστού στη Θεσσαλία του 17^{ου} αιώνα, συντήρηση εικόνων και ανάλυση χρωστικών*

Τούλη Β., Γκανέτσος Θ., Σδρόλια Σ., Αραμπατζής Σ., Κλιάφα Β., Παπαϊωάννου Ε. | *Αρχοντικό Γεωργίου Σβαρτς: Αρχαιομετρική προσέγγιση*

Daskalakis M.N., Ganetsos Th., Yiannouli E. | *Pigments on votives from Bronze Age Kapros on Kefalonia, the Ionian sea: Preliminary results from non-destructive spectroscopy techniques*

Daskalakis N., Ganetsos Th., Moraetis D., Papadopoulou E., Tzachili I. | *Materials analyses of stone votives from the Peak Sanctuary at Vrysinas (Rethymnon, Crete) applying spectroscopy techniques*

Mastrotheodoros G.P., Farmakalidis H.V., Konstanta A., Panou Th., Sampatakis A., Stasinopoulos S. | *Technical investigation of an outstanding Cretan icon*

Stamoulis K.C., Adam E., Agrafioti K.A., Asvestas A., Anagnostopoulos D.F. | *Elemental analysis of prehistoric chert artifacts from Kastritsa cave (Epirus, NW Greece) with the use of non-destructive XRF method*

Vivdenko S., Vasileiadou A., Tzanavari K., Malletzidou L., Paraskevopoulos K., Panagiotou K., Zacharias N. | *Archaeometric investigation of painting decoration in Derveni's Grave I, Thessaloniki*

Νέες και εδραιωμένες εφαρμογές στην Αρχαιομετρία / New and established applications in Archaeometry

Αργυρού Β.Γ. | *Ψηφιακό μουσείο, η χρησιμότητά του, τα απαραίτητα τεχνικά χαρακτηριστικά για την εφαρμογή του στον πολιτισμό. Ποια προγράμματα αναδεικνύουν τα ψηφιακά μουσεία, ποια η γνώμη των αρχαιολόγων για αυτά.*

Polymeris G.S., Martinis A., Minotou Ch., Poirazidis K., Skiadaressis A., Maniatis Y. | *Age assessment of monumental olive trees from the Ionian islands, Western Greece, using three different individual dating approaches*

Vafiadou A., Laskaris N., Kouki S., Tsoutsoumanos E., Polymeris G.S. | *Stimulated luminescence and obsidian hydration ages of archaeological interest from Greece and Turkey; an obvious hiatus within the 4th millennium BC*

Koulouri M. | *How the digitisation of a post-Inka Khipu artefact from Peru enabled a multivariate analysis for sign reduction*

Τετάρτη 18 Οκτωβρίου 2023 / Wednesday 18 October 2023**2^η Συνεδρία Αναρτημένων Ανακοινώσεων 14:00-15:30 / 2nd Poster Session 14:00-15:30****Ανόργανα υλικά - Κεραμικά και υαλώδεις ύλες / Inorganic materials - Ceramics and vitreous materials**

Menelaou S., Kouka O. | *Characterising pottery production and importation in Early Bronze Age Troy: Preliminary results from thin-section petrography*



- Pentedecka A., Kitis G., Aidona E., Sanjurjo Sánchez J., Triantafyllidis P., Polymeris G.S. | *Investigating ancient pottery technology: Assessment of maximum firing temperature in prehistoric Poliochni*
- Vivdenko S., Keramaris A., Vasileiadou A., Malletzidou L., Thanos A., Zacharias N. | *Archaeometrical investigation of figurines from the ancient cemetery in Sindos, western Thessaloniki, Greece*
- Kordali O., Oikonomou A., Kaparou M. | *Non-destructive investigation of corrosion patterns in vitreous Mycenaean materials*
- Παπαδάκης Μ., Καρύδας Α., Καπαρού Μ. | *Μελέτη αρχαιολογικής φαγεντιανής με Φθορισμομετρία Ακτίνων Χ: Τεχνολογία και παραγωγή*

Ανόργανα υλικά – Μέταλλα / Inorganic materials - Metals

- Φακορέλλης Γ., Μαραγκού Χ. | *Φυσικοχημική διερεύνηση παλαιομεταλλουργικής δραστηριότητας κατά την Ελληνιστική περίοδο στο Κάστρο της Μύρινας στη Λήμνο*

Πέμπτη, 19 Οκτωβρίου 2023 / Thursday, 19 October 2023

3^η Συνεδρία Αναρτημένων Ανακοινώσεων 14:00-15:30 / 3rd Poster Session 14:00-15:30

Βιοϋλικά και οργανικά κατάλοιπα / Biomaterials and organic residues

- Andriopoulou N.C., Christidis G.E. | *The effect of pH, temperature and time on the dissolution behaviour and composition of microscopic SiO₂-rich phytoliths: results from long-term batch laboratory experiments*
- Bantavanou P., Siegmund F., Moraitis K., Pavlidis P., Karakasi M.-V., Valakos E., Papageorgopoulou Ch. | *Histomorphometric method for age-at-death estimation on cremated human bones*
- Ciorpac-Petraru O.-M., Groza V.-M., Popovici M., Neagu A., Bejenaru L. | *Comparative histological approach of inflammatory reactions in three possible cases of treponematoses identified in human skeletons of 15th-19th centuries from Iasi, Romania*
- Georgiadou A., Zisis A., Ganiatsou E., Kallintzi K., Papageorgopoulou Ch. | *Investigating dietary patterns in the ancient colony of Abdera (Aegean Thrace, Greece). Stable isotope analysis ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) in human bone collagen*
- Groza V.-M., Bejenaru L., Pîrnău L., Popovici M., Ciorpac-Petraru O.-M. | *Past lives of ladies in Medieval Moldova: multidisciplinary approach of a female skeleton exhumed from a necropolis of 16th-17th centuries, in Iasi, Romania*
- Popovici M., Bilavschi G., Groza V.-M., Petraru O.-M., Bejenaru L. | *Assessing biological distance among medieval human populations from Eastern Romania*
- Souleles A., Korelidou M., Aidonis A., Ganiatsou E., Bantavanou P., Protopsalti T., Tzevreni S., Konstantinidou K., Vasileiadou S., Winkelbach L., Blöcher J., Diekmann Y., Burger J., Papageorgopoulou Ch. | *Urbanization from a population genetics perspective in Thessaloniki between 300 BC and 1500 AD*



Παρασκευή, 20 Οκτωβρίου 2023 / Friday, 20 October 2023

4^η Συνεδρία Αναρτημένων Ανακοινώσεων 14:00-15:30 / 4th Poster Session 14:00-15:30

Θετικές Επιστήμες στη Συντήρηση / Conservation Science

Θεοδωροπούλου Χ.Μ., Γιαννουλάκη Μ., Ρογκενμπούκε Μ. | *Μελέτη κατάστασης διατήρησης και συντήρησης σιδηρών ευρημάτων γεωμετρικών και αρχαϊκών χρόνων*

Boloti A., Boyiatzis S., Argyropoulou V., Giannoulaki M., Karatzani A. | *Interpretive approaches in the investigation of a field telephone from the Marathon Lake Museum*

Fardi Th., Haska E., Boyatzis S. | *The use of nanostructured fluids and gels for the cleaning of coated painted surfaces: A physicochemical assessment for the removal of Paraloid B72 from wall paintings*



Θεματική Συνεδρία: Λίθοι-Χρωστικές-Κονιάματα

Η τοιχογραφία με το κυνήγι από τον Τάφο του Φιλίππου Β' στις Αιγές: Μια νέα διεπιστημονική προσέγγιση με μη-επεμβατικές τεχνικές στα πλαίσια του ερευνητικού έργου ReVis

Χαρίκλεια Μπρεκουλάκη

Τομέας Ελληνικής και Ρωμαϊκής Αρχαιότητας, Ινστιτούτο Ιστορικών Ερευνών, Εθνικό Ίδρυμα Ερευνών, Βασιλέως Κωνσταντίνου 48, 11635, Αθήνα

Περίληψη

Η τοιχογραφία με το κυνήγι από τον Τάφο του Φιλίππου Β' στις Αιγές ήρθε στο φως από τις ανασκαφές του Μανώλη Ανδρόνικου το 1977 και αποτελεί ένα από τα σημαντικότερα έργα της αρχαίας ζωγραφικής που διατηρήθηκε ως σήμερα. Εξαιτίας της εκτεταμένης φθοράς της ζωγραφικής επιφάνειας σημαντικά μορφολογικά και εικονογραφικά στοιχεία είναι σήμερα δυσδιάκριτα ή μη-ορατά με γυμνό μάτι. Στόχος του έργου ReVis είναι η ανίχνευση, με μη επεμβατικές τεχνικές διάγνωσης και απεικόνισης, των χρωστικών υλών και της τεχνικής που ακολουθήθηκε για την εκτέλεση της τοιχογραφίας σε όλο της το εύρος, καθώς και η αναγνώριση μη-ορατών σήμερα στοιχείων. Παράλληλα, το έργο ReVis αναδεικνύει τη σημασία της διεπιστημονικότητας και τη δυνατότητα συμβολής της τεχνολογίας στην προσπάθεια μιας νέας πρότασης αποκατάστασης της τοιχογραφίας, η οποία θα επιτρέπει την καλύτερη κατανόηση της εικονογραφίας της και της καλλιτεχνικής της αξίας.



Μελέτη φυσικών και συνθετικών χρωστικών Ultramarine με Φυσικοχημικές Μεθόδους

Αναστασία Πουρλιάκα, Λαμπρινή Μαλλετζίδου, Τριανταφυλλιά Ζορμπά, Κωνσταντίνος

Παρασκευόπουλος, Ελένη Παυλίδου, Γεώργιος Βουρλιάς

*Εργαστήριο Προηγμένων Υλικών και Διατάξεων, Τμήμα Φυσικής, Σχολή Θετικών Επιστημών, Αριστοτέλειο
Πανεπιστήμιο Θεσσαλονίκης, ΤΚ 54124, Θεσσαλονίκη*

Περίληψη

Μια από τις σπουδαιότερες χρωστικές στην ιστορία της τέχνης είναι η μπλε Ultramarine που προέρχεται από το lapis lazuli και εξορύσσεται στο Αφγανιστάν από την αρχαιότητα. Η παραγωγή μιας συνθετικής και λιγότερο δαπανηρής εκδοχής από τον Guimet το 1828 επέφερε μια σημαντική αλλαγή στις παλέτες των καλλιτεχνών [1]. Σε ένα έργο είναι ζωτικής σημασίας να εξακριβωθεί εάν η συγκεκριμένη χρωστική είναι φυσική ή συνθετική, για λόγους αυθεντικότητας, εντοπιότητας ή και τεχνοτροπίας του εκάστοτε καλλιτέχνη. Μέχρι σήμερα, ο διαχωρισμός αυτός πραγματοποιείται κυρίως από μεθόδους μικροσκοπίας, ενώ έχουν προταθεί και άλλες μέθοδοι (FTIR, FORS κ.α.) [2]. Σκοπός της παρούσας εργασίας είναι η μελέτη εμπορικά διαθέσιμων χρωστικών ultramarine φυσικής και συνθετικής προέλευσης, με διάφορες μεθόδους χαρακτηρισμού, με στόχο την απόδοση ενός αναλυτικού πρωτοκόλλου χαρακτηρισμού και διαχωρισμού της προέλευσης της χρωστικής. Οι χρωστικές μελετήθηκαν με οπτική μικροσκοπία, φασματοσκοπία υπεριώθρου με μετασχηματισμό Fourier (FTIR), περίθλαση ακτίνων Χ (XRD), ηλεκτρονική μικροσκοπία σάρωσης (SEM-EDS) και φασματοφωτομετρία ορατού-υπεριώδους (UV-Vis), με την απόδοση των αποτελεσμάτων τους να αφορά τη στοιχειακή σύνθεση, τη μορφολογική ανάλυση των κόκκων, τον προσδιορισμό της κρυσταλλικής φάσης και τον υπολογισμό των δεικτών χρώματος των χρωστικών [3]. Παράλληλα, χρησιμοποιήθηκαν επιπρόσθετες μέθοδοι για την απόδοση διαφοροποιήσεων, όπως η φασματοσκοπία φωτοηλεκτρονίων ακτίνων-Χ (XPS) και η θερμοβαρυμετρία (TGA) [4].

Βιβλιογραφία

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Διερευνώντας την πολυχρωμία των αρχιτεκτονικών μελών του Πεισιστράτειου Τελεστηρίου στο

Ιερό της Δήμητρας και Κόρης στην Ελευσίνα

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Περίληψη

Στη μελέτη αυτή παρουσιάζονται τα αποτελέσματα της διερεύνησης των χρωματικών στρωμάτων σε αρχιτεκτονικά μέλη από το θριγκό του Πεισιστράτειου Τελεστηρίου, του σημαντικότερου κτηρίου του Ιερού, ως χώρου των Ελευσινίων Μυστηρίων. Στο εσωτερικό του Τελεστηρίου, στο Ναό της Δήμητρας, φυλάσσονταν τα ιερά αντικείμενα και επιπλέον λάμβανε χώρα μια ιεροτελεστία την οποία παρακολουθούσε μεγάλο πλήθος μυημένων. Οι τοίχοι του σηκού, οι κίονες και ο θριγκός ήταν κατασκευασμένοι από πωρόλιθο ενώ η αετωματική, δίρριχτη, στέγη με κορινθιακό σύστημα κεράμωσης, από παριανό μάρμαρο. Οι ηγεμόνες καλυπτήρες είχαν ανθεμωτή διακόσμηση και διασώζουν εκτενή ίχνη χρώματος. Η εξέταση της ζωγραφικής επιφάνειας στα μαρμάρινα ακροκέραμα και στο κεφάλι του κριού από τη γωνία της σίμης, πραγματοποιήθηκε με μη-καταστρεπτικές μεθόδους διάγνωσης μέσω φορητών διατάξεων όπως η απεικονιστική μέθοδος της ορατής επαγόμενης φωταύγειας (VIL imaging technique), αλλά και φορητή φασματοσκοπία FT-IR και Raman και στοιχειακή ανάλυση με φορητή διάταξη φθορισμετρίας ακτινών Χ (XRF). Τα αποτελέσματα επιβεβαίωσαν τη χρήση του Αιγυπτιακού κυανού σε συνδυασμό με άλλες φυσικές κυανές και πράσινες χαλκούχες χρωστικές, ενώ η εξέταση κιτρινωπών και ερυθρών αποχρώσεων, παρείχε στοιχεία για την αναγνώριση επιπλέον χρωστικών, τεκμηριωμένων από τη σχετική βιβλιογραφία για την πολυχρωμία στην αρχαία ελληνική αρχιτεκτονική [2, 3].

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The Effects of Fire on Wall Paintings: *In-situ* following the thermal degradation of painting binders with a DRIFT environmental chamber

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Abstract

Wall painting technique criteria of identification is an on-going subject of research. The presence or absence of organic binders in the painting layers of wall paintings is considered to be one of the earlier and established of the as-said criteria, as it depicts the use of the *secco* or the *fresco* techniques. Towards the possibility of detecting organic binders in the painting layers of wall paintings in buildings that have undergone a fire incident, wall painting mock-ups were subjected to a fire protocol designed to simulate compartment fires (Hajpál and Török, 2004), followed by Fourier transform infrared (FTIR), X-rays diffraction (XRD), thermogravimetric (TGA) and UV-Vis spectrophotometric analyses. Under this applied protocol, the upper temperature limit for maintaining the integrity of the mock-ups was defined at 400-500 °C (Malletzidou et al., 2023).

This work is dealing with the *in-situ* observation of the thermal degradation of the most usual organic binders (egg yolk, casein, linseed oil and gum Arabic) with diffuse reflectance FTIR (DRIFT) spectroscopy, using a gas-purged high-temperature environmental chamber. Furthermore, X-rays photoelectron spectroscopy (XPS) measurements showed that up to this temperature limit, indications remain regarding the applied binder/technique of painting.

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Πετρογραφική μελέτη εμφανίσεων οφίτη (σερπεντινίτη) στην Κρήτη. Αναζήτηση προέλευσης της πρώτης ύλης ευρημάτων της Ζάκρου

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Περίληψη

Η παρούσα έρευνα, η οποία πραγματοποιήθηκε στο πλαίσιο διδακτορικής διατριβής, χρησιμοποιεί ως βάση της μία πετρογραφική μελέτη λεπτών τομών γεωλογικών δειγμάτων από περιοχές της Κρήτης, οι οποίες θεωρήθηκαν εμφανίσεις του λίθου οφίτη (σερπεντινίτη), σε σύγκριση με την εξέταση λεπτών τομών από αρχαιολογικά ευρήματα από οφίτη της μινωικής Ζάκρου. Στόχοι της έρευνας αποτέλεσαν η εξακρίβωση του είδους του λίθου των αντικειμένων της Ζάκρου που επιλέχθηκαν, και εν συνεχεία, ο εντοπισμός πιθανών γεωλογικών πηγών από τα οποία προέρχεται το υλικό της θέσης. Έγινε μία προσπάθεια να διαπιστωθούν κάποια πιθανά δίκτυα διακίνησης ενός λίθου ευρέως διαδεδομένου στο νησί, εφόσον δείχθηκε ότι κύριες πιθανές πηγές προέλευσής του στη Ζάκρο υπήρξαν οι εμφανίσεις του στην περιοχή της Σύμης και στο οροπέδιο του Καθαρού, και, δευτερευόντως, ίσως το νησάκι Χρυσή.

Η συλλογή των γεωλογικών δειγμάτων έγινε με επιτόπια έρευνα και η μελέτη των λεπτών τομών πραγματοποιήθηκε με τη μέθοδο της πετρογραφίας, στα οπτικά μικροσκόπια του τμήματος Γεωλογίας και Γεωπεριβάλλοντος του ΕΚΠΑ. Τα αποτελέσματα της μεθόδου που επιλέχθηκε προσφέρουν μία πρώτη εικόνα σχετικά με την προέλευση του υλικού της Ζάκρου, η οποία υποδεικνύει και ενδεχόμενες περαιτέρω επαφές της θέσης με τις περιοχές αυτές, ενώ, παράλληλα, συνιστούν ένα αρχικό βήμα για περαιτέρω διερεύνηση του θέματος με εφαρμογή περισσότερων αρχαιολογικών μεθόδων στο ίδιο υλικό.

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Διαγνωστικό πρωτόκολλο τέχνηργων στο Εργαστήριο Συντήρησης Γλυπτών του Εθνικού Αρχαιολογικού Μουσείου: Ένα μεθοδολογικό στάδιο στο πλαίσιο των εργασιών συντήρησης

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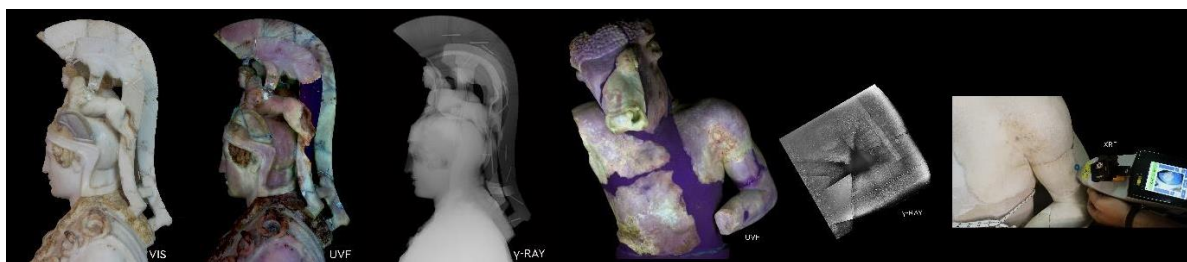
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Περίληψη

Το Εργαστήριο Συντήρησης Γλυπτών εφαρμόζει ένα διαγνωστικό πρωτόκολλο, που περιλαμβάνει απεικονιστικές και αναλυτικές τεχνικές για την ανίχνευση, ανάλυση και τεκμηρίωση της εξωτερικής επιφάνειας και της εσωτερικής δομής των αρχαιοτήτων. Στο πλαίσιο του πρωτοκόλλου εφαρμόζονται διάφορες φωτογραφικές τεχνικές (VIS, RTI, UVF, UVR, VIL, IR) για τη διερεύνηση των χρωματικών καταλοίπων σε αρχαία έργα και προηγούμενων επεμβάσεων σε αυτά καθώς και ακτινογράφιση (x-RAY, γ-RAY), κυρίως για τη διερεύνηση της εσωτερικής συνδεσμολογίας ανασυσταθέντων γλυπτών. Επιπλέον, χρησιμοποιείται η αναλυτική μέθοδος φθορισμού ακτίνων x (XRF), με μη επεμβατική οργανολογία, για τον προσδιορισμό των χημικών στοιχείων (ποιοτική-ποσοτική ή στοιχειακή ανάλυση) από τα οποία αποτελούνται τα διάφορα ανόργανα υλικά και ύλες που απαντώνται στα αρχαία.

Τα αποτελέσματα του διαγνωστικού πρωτοκόλλου βρίσκουν εφαρμογή στις ποικίλες δραστηριότητες του Τμήματος Συντήρησης, Χημικών - Φυσικών Ερευνών & Αρχαιομετρίας του Εθνικού Αρχαιολογικού Μουσείου. Ορισμένες εξ αυτών είναι η προληπτική και επεμβατική συντήρηση, η τεκμηρίωση, η μελέτη, ο σχεδιασμός, και η εφαρμογή υποστηριγμάτων έκθεσης και αποθήκευσης, ο έλεγχος γνησιότητας, ο έλεγχος της κατάστασης διατήρησης αρχαιοτήτων για τον δανεισμό τους σε περιοδικές εκθέσεις, ο καθορισμός των προδιαγραφών της μεταφοράς τους καθώς και οι επικοινωνιακές δράσεις του Μουσείου.



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Ο ρόλος των λίθινων πρώτων υλών στη κατασκευή μακρολιθικών εργαλείων της Πρώιμης

Εποχής του Χαλκού στο Κορωπί Αττικής: πετρογραφικά χαρακτηριστικά και πιθανή προέλευση

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Περίληψη

Η επιλογή της κατάλληλης ύλης για την κατασκευή ανθεκτικών εργαλείων ανταποκρινόμενων στις πολύπλευρες ανάγκες μίας προϊστορικής αγροτοκτηνοτροφικής κοινότητας με έντονες ενδείξεις πρώιμης αστικοποίησης στις αρχές της 3^{ης} χιλ. π.Χ. αναδεικνύεται ως βασικός τεχνολογικός παράγοντας. Η παρούσα έρευνα αφορά στη μακροσκοπική εξέταση 1.200 λίθινων τέχνεργων από τον πρωτοελλαδικό οικισμό του Κορωπίου, στα οποία αντιπροσωπεύονται όλοι οι λειτουργικοί τύποι των εργαλείων τριβής και άλεσης, λείανσης και κρούσης. Η ανάλυση των τέχνεργων, οδήγησε στη διαπίστωση ότι οι λίθοι από τα οποία είναι κατασκευασμένα τα τέχνεργα προέρχονται από πετρώματα κάθε γεωλογικής προέλευσης.

Η πετρογραφία επιλέχθηκε ως βασική μέθοδος προσδιορισμού ορυκτολογικών και ιστολογικών χαρακτηριστικών της πρώτης ύλης των τέχνεργων με την επιλογή δειγμάτων από διαφορετικές εργαλειακές κατηγορίες. Η μικροσκοπική εξέταση σαράντα (40) λεπτών τομών δειγμάτων προερχομένων από διαφορετικούς εργαλειακούς τύπους, επιβεβαίωσε ότι στις λιθοτεχνίες του Κορωπίου οι πρώτες ύλες αποτελούνται από πυριγενή, ιζηματογενή και μεταμορφωμένα πετρώματα με διαφορετικό ποσοστό εμφάνισης σε κάθε κατηγορία. Παρατηρήθηκε ότι για τον κάθε τύπο εργαλείου και τη προοριζόμενη χρήση του, υπήρχε προτίμηση στη χρήση συγκεκριμένων πετρωμάτων ως πρώτη ύλη κατασκευής. Επομένως, ο σχεδιασμός και η λειτουργικότητα του κάθε εργαλείου επηρέαζε σε μεγάλο βαθμό τη διαδικασία επιλογής της κατάλληλης πρώτης ύλης από τον προϊστορικό τεχνίτη.

Αναζητώντας πιθανές πηγές προέλευσης των πρώτων υλών εκτός της περιφέρειας της αρχαίας θέσης, η έρευνα προχώρησε στην δειγματοληψία γεωλογικών δειγμάτων από περιοχές όπου εντοπίζονται εμφανίσεις αυτών των πετρωμάτων. Η μεταφορά πρώτων υλών και τέχνεργων αποτελούν ενδείξεις ιχνηλάτησης του προϊστορικού δικτύου, χερσαίου και θαλάσσιου, της ανάπτυξης του εμπορίου και της διακίνησης αγαθών κατά την Πρώιμη Εποχή του Χαλκού στο κεντρικό ελλαδικό χώρο και την περιοχή του Αργοσαρωνικού κόλπου.

Τα αποτελέσματα της έρευνας αυτής μπορούν να αποτελέσουν την αφετηρία για τη δημιουργία μίας βάσης δεδομένων σχετικά με τις πρώτες ύλες κατασκευής των μακρολιθικών τέχνεργων στην Αττική κατά την Πρώιμη Εποχή του Χαλκού.



Ελαφροβαρή επιχρίσματα για αποκαταστάσεις ιστορικών κατασκευών

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Περίληψη

Το επίχρισμα είναι ένα είδος κονιάματος που λόγω της θέσης του στις κατασκευές βελτιώνει την εμφάνιση των τελικών επιφανειών ενώ παράλληλα λειτουργεί ως καλυπτικό, θερμομονωτικό και ηχομονωτικό υλικό (Veiga et al., 2010). Ο πολλαπλός αυτός ρόλος καθιστά το επίχρισμα ένα από τα πιο ευάλωτα υλικά της κατασκευής. Η χρήση ελαφροβαρών επιχρισμάτων με βάση τον ασβέστη δεν είναι μία νέα ιδέα καθώς έχουν χρησιμοποιηθεί σε κτίρια εδώ και αιώνες. Ωστόσο, η έρευνα αλλά και η εφαρμογή τους έχει αυξηθεί καθώς η επιδίωξη είναι να μειωθεί το αποτύπωμα του άνθρακα στα κτίρια, και να βελτιώνεται η ενεργειακή απόδοση των κτιρίων (Asadi et al., 2018). Στην παρούσα έρευνα ο σχεδιασμός των επιχρισμάτων βασίστηκε στις αρχές συμβατών κονιαμάτων (Στεφανίδου, 2008) δίνοντας έμφαση στη χρήση ελαφροβαρών αδρανών και προσμίκτων με στόχο την ισορροπία φυσικών και μηχανικών ιδιοτήτων αλλά και χρήση αρχών αειφορίας. Ως κονίες χρησιμοποιήθηκαν υδράσβεστος και ποζολάνη ως βιομηχανικό παραπροϊόν, ενώ στα αδρανή χρησιμοποιήθηκε περλίτης, υλικά αλλαγής φάσης (PCM) και ανακυκλωμένο πλαστικό PET. Στις συνθέσεις που παρασκευάστηκαν ελέγχθηκαν ιδιότητες σε νωπή κατάσταση (εργασιμότητα, workable life, air- content) ενώ πραγματοποιήθηκαν έλεγχοι φυσικών (συρρίκνωση, αποτίμηση του ανοικτού πορώδους, συντελεστής τριχοειδούς ανύψωσης), μηχανικών ιδιοτήτων (κάμψη και θλίψη) και θερμικών ιδιοτήτων, (θερμική αγωγιμότητα) σε ηλικία 28 και 90 ημερών. Η μερική αντικατάσταση των αδρανών από το ελαφριά υλικά δίνει πολλά υποσχόμενα αποτελέσματα όσον αφορά στη μηχανική και θερμική απόδοση των επιχρισμάτων. Η βελτίωση της θερμικής απόδοσης οδηγεί σε εξοικονόμηση ενέργειας στα κτίρια και καθιστούν τα υλικά αυτά βιώσιμα.

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An Archaeometric Study of Hydraulic Plasters from the Roman Public Baths of Kourion, Cyprus

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Abstract

The goal of this paper is to characterize the plasters used at the Roman Baths of Kourion, Cyprus. Despite the intentional early use of crushed brick, as an artificial hydraulic additive in plaster production, in the Late Bronze Age in Cyprus (Theodoridou, Ioannou and Philokyprou, 2013), there has not been further research on the use of hydraulic plasters and/or mortars from other historic periods on the island. Hence, the relevance and significance of this paper.

The archaeological site of Kourion is located in the south coast of Cyprus, close to the village of Episkopi. One of the most prominent monuments of this archaeological site is the Public Baths complex, north-west of the Roman Agora (Χρίστου, 2013). In total, fourteen plaster samples were examined from the cisterns, the caldarium and the tepidarium of the west and east bath complexes.

A variety of archaeometric techniques were adopted to identify the main physicochemical characteristics of the aforementioned historic construction materials. These included macroscopic observations (hand-held microscope, Munsell color identification), chemical analysis using a portable handheld X-ray Fluorescence spectrometer, petrographic analysis, Scanning Electron Microscopy paired with energy Dispersive X-ray microanalysis and Cathodoluminescence and Thermal Analysis. The results confirm the use of opus signinum (cocciopesto) at the top layers, over a lime plaster substrate. The top hydraulic layers in some cases comprised of either multiple layers or a non-homogeneous poorly mixed plaster. The presence of opus signinum signifies that the production of plasters at the archaeological site of Kourion was influenced by the locally available raw materials and the technology known during the Roman period (Vitruvius, 1960).

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Archaeometric investigation of post-Byzantine icons by means of macroscopic XRF

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Abstract

Post-Byzantine icons –i.e. post-1453 A.D. Greek Orthodox Christian panel paintings– are important cultural heritage assets that reflect the trends of an idiomorphic branch of European post-Renaissance painting. The interest of scholars for the identification of icons' painting materials and techniques has increased considerably lately, and this reflects on the enrichment of the technical literature with many pertinent archaeometric studies [1,2]. Most of the latter studies are primarily based on the employment of destructive or micro-destructive analytical techniques, yet quite recently, a new, extremely powerful and non-invasive analytical tool became available for such studies; macroscopic X-ray fluorescence analysis (MA-XRF) allows for the rapid scanning of relatively large surfaces (~1×1 m²) and the creation of corresponding elemental distribution maps [3]. In the current work authors demonstrate results obtained from the MA-XRF investigation of numerous post-byzantine icons. Based on the critical evaluation and the proper processing of the relevant MA-XRF data, the examined icons' painting materials and techniques are identified, while their state of preservation is documented as well [4].

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Διάγνωση και ερμηνεία μιας επιζωγραφισμένης εικόνας μέσω αναλυτικών τεχνικών: Η

περίπτωση της εικόνας «Παναγία με αγίους» (Nr.In.3622)

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Περίληψη

Η εικόνα «Παναγία με αγίους» με αριθμός αποθέματος Nr.In.3622, προέρχεται από την εκκλησία του Αγίου Γεωργίου του Μπερατίου, στη νότια Αλβανία. Πλέον, η εικόνα φυλάσσεται στη Συλλογή του Εθνικού Μουσείου Μεσαιωνικής Τέχνης Κορυτσάς. Το ενδιαφέρον της εικόνας αποδίδεται στην ύπαρξη δύο επάλληλων στρωμάτων ζωγραφικής και στην αναγνωρίσιμη επιζωγράφιση σε ολόκληρη την επιφάνειά της.

Ο συνδυασμός μη-επεμβατικών και επεμβατικών τεχνικών ως μεθοδολογία της παρούσας έρευνας στόχευε: στην πλήρη διερεύνηση της παθολογίας της εικόνας, στην κατανόηση της στρωματογραφίας της, στην ταυτοποίηση των συστατικών υλικών της, αλλά κυρίως στην απόκτηση πληροφοριών σχετικά με τις διαφορετικές μεταγενέστερες επεμβάσεις.

Αρχικά, εφαρμόστηκε η τεχνική Ακτινογραφίας (X-rays), η οποία έδωσε πληροφορίες κυρίως για το πρώτο ζωγραφικό στρώμα, αλλά και για διαφορετικές φθορές που επιβαρύνουν την κατάσταση διατήρησης της εν λόγω εικόνας. Ακολούθησε δειγματοληψία από επτά διαφορετικά σημεία της. Συγκεκριμένα: πέντε από τα δείγματα λήφθηκαν από τα δύο επάλληλα ζωγραφικά στρώματα, ένα προέρχεται από τον ξύλινο φορέα και ένα από το ύφασμα της εικόνας.

Για την ταυτοποίηση των χρωστικών και των ανόργανων υλικών που χρησιμοποιήθηκαν για την κατασκευή της εικόνας, εφαρμόστηκε η τεχνική SEM-EDS. Η Ηλεκτρονική Μικροσκοπία Σάρωσης χρησιμοποιήθηκε για την παρατήρηση ινών του υφάσματος και του ξύλινου φορέα της εικόνας.

Η εφαρμογή της τεχνικής Φασματοσκοπίας Υπέρυθρου (ATR-FTIR και μ-FTIR) συνέβαλε στην ταυτοποίηση ορισμένων οργανικών και ανόργανων συστατικών. Η ερμηνεία των αποτελεσμάτων των ανωτέρω τεχνικών αποκάλυψε ότι διασώζεται το πρώτο ζωγραφικό στρώμα της εικόνας σε μεγάλη έκταση. Επιπλέον, το σύνολο των τεχνικών που εφαρμόστηκαν συνέβαλλε στην αποσαφήνιση της αρχικής ζωγραφικής σύνθεσης. Οι αποκαλυφθείσες επιγραφές και ο τύπος γραφής τους αξιοποιήθηκαν ως μέσα χρονολόγησης της εικόνας.

Λαμβάνοντας υπ' όψη τα τεχνοτροπικά στοιχεία και τον τύπο επιγραφών του πρώτου ζωγραφικού στρώματος που αποκαλύφθηκε συμπεραίνουμε ότι η αρχική ζωγραφική φάση θα μπορούσε να χρονολογηθεί στον 17^ο αιώνα, ενώ η δεύτερη ζωγραφική φάση, να τοποθετηθεί στον 19^ο αιώνα με αρκετή βεβαιότητα.

Ευχαριστίες

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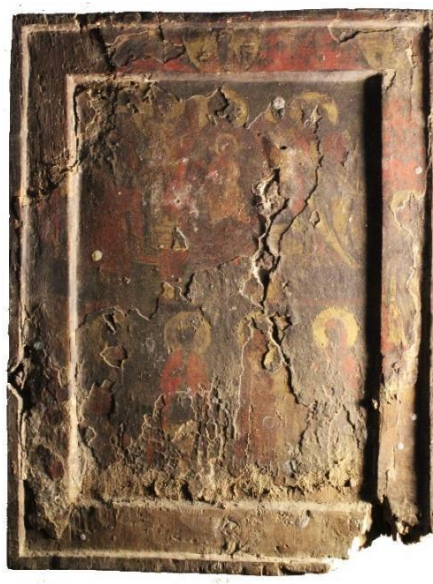
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Εικ. 1. Η εικόνα «Παναγία με αγίους



Εικ. 2. Η εικόνα «Παναγία με αγίους



A comprehensive review and meta-analysis of compositional analyses of archaeological obsidian tools and evaluation of the discrimination of the Greek obsidian sources

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Abstract

This study presents a comprehensive review of scientific literature and meta-analysis of the corresponding data, focusing on the elemental analysis of archaeological obsidian tools from Greek excavation sites. Our primary objective is to review the progression in methodology, results, and techniques used for obsidian provenance studies and evaluate their ability to determine sub-sources. Various analytical techniques for elemental composition, such as XRF, ICP, and SEM-EDX, have been used over the years to differentiate between obsidian sources. A significant aspect of this work involves assessing the effectiveness of these techniques in reliably identifying obsidian sources. Initially, we compiled chemical composition results from the literature and categorized them based on the analytical technique used. This data was then subjected to various algorithms (meta-analysis and clustering) as well as data analysis procedures, including Principal Component Analysis (PCA) and Hierarchical Cluster Analysis (HCA). The aim was to identify optimal techniques and analytical procedures towards differentiating between Greek obsidian sources, with an emphasis on distinguishing sub-sources based on trace elements. All over Greece only four major sources are known; these are Melos – Adamas, Melos – Demenegaki, Yali Island and Antiparos Island. From an archaeological point of view a permanent question is the source of the archaeological obsidian artefact and from a geological aspect if these are the only obsidian sources or just the major and well known. Through this review, we aim to contribute to obsidian studies by providing an overview of trends in obsidian analysis, identifying the most reliable techniques, and exploring the future of source and sub-source differentiation. Additionally, this study compares the elemental composition analyses of bulk obsidian areas (obtained with SEM) with the results from various inclusions within the obsidian matrix. This comparison reveals differences between the homogeneous matrix and the heterogeneous inclusions, providing a more in-depth understanding of obsidian source geochemistry.



Θεματική Συνεδρία: Νέες και εδραιωμένες εφαρμογές στην Αρχαιομετρία

Ανασκόπηση της διακύμανσης του φαινομένου της θαλάσσιας δεξαμενής στο Αιγαίο Πέλαγος κατά τα τελευταία 13.000 χρόνια cal BP και οι επιπτώσεις της στη χρονολόγηση με ^{14}C

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Περίληψη

Είναι γνωστό ότι η ειδική ενεργότητα ^{14}C του διαμερίσματος της θάλασσας της παγκόσμιας δεξαμενής ανταλλαγής του άνθρακα διαφέρει από εκείνη της ατμόσφαιρας λόγω των πολύ διαφορετικών χρόνων παραμονής των ατόμων άνθρακα σε αυτά. Ωστόσο, το μέγεθος αυτού του φαινομένου μπορεί να διαφέρει από περιοχή σε περιοχή λόγω διαφόρων γεωλογικών και κλιματικών παραγόντων. Ένας τρόπος για τον υπολογισμό της τοπικής επίδρασης του διαμερίσματος της θάλασσας $R(t)$ και της τοπικής απόκλισης ΔR είναι η ραδιοχρονολόγηση με ^{14}C ζευγών δειγμάτων χερσαίας-θαλάσσιας προέλευσης, που έχουν συλλεχθεί από το ίδιο κάθε φορά αδιατάρακτο αρχαιολογικό στρώμα.

Αρχαιολογικές ανασκαφές σε δεκατέσσερις μέχρι σήμερα παράκτιες αρχαιολογικές θέσεις παρείχαν συνολικά εξήντα δύο τέτοια ζεύγη η ηλικία των οποίων κυμαίνεται από περίπου 13.000 χρόνια cal BP μέχρι σήμερα. Οι ηλικίες τους ^{14}C βαθμονομήθηκαν με τη χρήση των τελευταίων εκδόσεων των διεθνών καμπυλών βαθμονόμησης IntCal20 και Marine20 κι επέτρεψαν τον υπολογισμό των αντίστοιχων τιμών $R(t)$ και ΔR κατά τη διάρκεια της προαναφερθείσας χρονικής περιόδου. Τα αποτελέσματα δείχνουν ότι οι τιμές αυτές δεν είναι σταθερές συναρτήσει του χρόνου και μπορεί να μεταβάλλονται σημαντικά. Επιπλέον, παρέχουν το πλαίσιο και την αιτιολόγηση για πιο ολοκληρωμένες και μεγαλύτερης κλίμακας μελέτες με έμφαση στο παλαιοκλίμα και την παλαιοωκεανογραφία, οι οποίες μπορεί να οδηγήσουν στη δημιουργία μίας ολοκληρωμένης καμπύλης διόρθωσης των συμβατικών ηλικιών ^{14}C δειγμάτων θαλάσσιας προέλευσης για ολόκληρη την περιοχή του Αιγαίου.

Βιβλιογραφία

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Innovations in imaging of the subsurface of archaeological sites and the interior of structural elements of monuments in 3 and 4 dimensions developed in the framework of the EKATY project

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Abstract

The project under the acronym **EKATY** (to remind Hecate, the ancient Greek goddess of ghosts and necromancy) **runs under the Operational Programme Competitiveness, Entrepreneurship and Innovation 2014-2020 (EPAnEK)**. Its main activities focus on the development of innovative approaches, and consequently on the relevant instruments and software for imaging buried antiquities, but also for monitoring the moisture impregnation and cracks evolution in standing monuments.

Regarding the exploration of the interior of tumuli, Muon and gravimetric tomography, along custom developed measuring protocols and data processing schemes for 3-Dimensional Electrical Resistivity Tomography (3D ERT) and 3D seismic tomography were employed. The experiments held at the great tumulus of Apollonia were considered successful revealing the structure of the interior and detecting anomalies that are possibly caused by concealed monumental tombs. Thus, a poly-methodological tomography is introduced aiming to guide the fore coming excavations and preserve the integrity of the tumuli.

Recently developed image fusion algorithms in our Lab, were introduced. The experiments showed that fused data provide better visualizations than separately each one of the geophysical methods employed. Tests of the proposed schemes were mainly performed mainly in the site of ancient Philippoi, demonstrated the reliability and effectiveness of the proposed algorithms.

Finally, time lapse electrical resistivity tomography algorithms and Ground Penetrating Radar (GPR) data acquisition and processing algorithms were established to monitor failures and impregnating moisture within the structural elements of monuments. The arrays were installed in the emblematic monument of Rotunda. The tests carried out, yielded the optimum electrode arrangement for this kind of operations. Further, least squares inversion algorithms were modified to cope with the particular setting.



A modular custom-built Macro-XRF spectrometer for Heritage Science

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Abstract

Scanning XRF spectrometry (Macro-XRF) is nowadays a widely established imaging technique for Heritage Science applications. By means of raster scanning, it allows the non-destructive elemental mapping of large, mostly flat, surfaces generating images of elements distribution, well perceived by non-expert curators, archaeologists, conservators, and art-historians. The MA-XRF images allow a firmly and enhanced characterization of the elemental composition of ancient artifacts and historical artworks/materials, providing useful insights into the manufacturing process, but also to surface corrosion products and processes [1].

This contribution presents the development and characterization of a modular portable MA-XRF spectrometer. The system consists of a transmission 12W Rh anode X-ray tube, a silicon drift detector (SSD) of a 150 mm² active area and a laser proximity sensor integrated on a three-axis motorized platform (75cm x 50cm x 25cm). The setup is controlled by an in-house developed LabView program. Modular optics, including a polycapillary X-ray lens and diaphragms of variable diameters provide a tunable sized exciting beam from ~0.1mm to several mm's, optimized for different applications.

Monte Carlo simulations were applied to characterize the excitation spectrum in terms of energy distribution, spatial resolution, and divergence in various optic-to-sample distances. First archaeometrical applications will be reported to demonstrate the advanced analytical capabilities and performance of the newly developed MA-XRF spectrometer.

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Study and Documentation of Late Bronze Age (LH IIIA1 period) Pottery From “Vagia”, Kalapodi

East Locris Greece: The Use of 3d Scanning Technology and 3d Color Printing

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Abstract

The paper presents and discusses the use of digital technology on four ceramic artifacts, burial offerings from a Late Bronze Age chamber-tomb unearthed in Eastern Central Greece. The organized Mycenaean chamber-tomb cemetery is situated at the site “Vagia”, 1 km west of the modern village of Kalapodi Phthiotis Greece and was discovered during rescue excavations of the Department of Prehistoric and Classical Antiquities /Ephorate of Phthiotida and Evrytania of Greek Ministry of Culture. The four vessels we will examine are only a part of the wider archaeological context of the findings uncovered inside the monumental chamber- tomb T.I. that had rectangular shape and a pitched roof. The alabasters (K 4364, K 4365) (FS 84) are decorated with rock pattern (FM 32), the small goblet (K 4410) FS 254 is decorated with a foliated band (FM 64) and the early sample of the carinated conical cup (K 4409) FS 230 also decorated with rock pattern (FM 32). All vessels are made of high-quality clay, probably manufactured in a local Mycenaean ceramic workshop and the color of the decoration varies from dark brown to light orange.

The artifacts were 3D scanned with a EinScan Pro 2X Plus (Shining 3D Tech. Co., Ltd.) using Shining Software. A post-processing procedure was conducted in the 3D Scanner’s software in order to create the final digital CAD file. This file can be then forwarded for fabrication by using a 3D Color Printer that is in a position to attribute the scanned item’s geometry and colors.

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Reevaluation of mathematical and tunnelling aspects of the Eupalinos' aqueduct

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Abstract

The Eupalinos' aqueduct on Samos, in ancient Greece, has been highlighted as an exceptional engineering project of the sixth century BC, as well as a mathematical problem studied already in antiquity by Heron. It is re-examined in the present article from two points of view, and primarily based on the revised historical context regarding the biography of two great Samians, the tyrant Polycrates and Pythagoras. It has been previously supported that "the frequent assertion that Polycrates sought an architect for an aqueduct and invited Eupalinos from Megara is not tenable. The tunnel began, according to all the indications, as early as ca. 550 B.C. and would therefore have been completed before the time of the famous tyrant".

The traditional chronographic date for Polycrates' accession, ca. 533 B.C., has been placed in serious doubt by scholars who argue convincingly for a date in the early 540s B.C. As for Pythagoras, his biographers agree that he was born around 570 B.C. and that at the age of about forty he settled at Crotona in Southern Italy. He was therefore in Samos during the period of the great works of Polycrates, with a temporary absence in Egypt and elsewhere. Without doubt, both the Eupalinos' aqueduct and the temple of Heraion, presupposed careful application of mathematics and project design and this aspect is examined in depth.

The second reason for revision is that the interpretations that have been given for the design and completion of the aqueduct oversimplify the contribution of mathematics, ignore the problem of ventilation in the opening of a blind gallery six hundred meters long and are based on paradoxical assumptions, such as that during the construction of the project the aqueduct's supply source was moved four meters lower, notably without this being connected to any earthquake, the main tunnel was found lower than the source and for this reason a second gallery was built for the ceramic water pipes lower and since then the source remains to this day in her place.



An astronomical precise dating of Odysseus' return to Ithaca

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Abstract

The annular solar eclipse, of 30 October 1207 B.C. (Julian Day-JD 1280869), calculated by NASA together with the analysis of the weather's and the environment's description (long nights, plants, animals and peoples' habits) and the astronomical data (guiding constellations and Venus the planet in the east horizon) mentioned by Homer in the epic, constitute a corpus of information. The result of the analysis of the corpus offers the first precise astronomical dating, without error bars at all, of Odysseus' returned to Ithaca in the autumn five days before the pre-mentioned eclipse. The latter is connected with another astronomical event meaning the planet Venus found in the eastern horizon utilizing, the tool of dating which is the software Starry Night. The two astronomical events the eclipse and Venus' position in the prehistoric sky of the Ionian Islands confirmed fully the prehistoric text.



Advanced X-ray based methodologies for the non-invasive investigation of tangible Cultural Heritage

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Abstract

XRAYLab is a laboratory of the Institute of Heritage Sciences (CNR-ISPC) in Catania dedicated to the development of novel X-ray-based methodologies for the non-invasive investigation of cultural objects and archaeological materials. It operates as a node of the MOLAB platform of E-RIHS (European Infrastructure for Heritage Science), providing free access to users to integrated multi-diagnostics that enable the most effective in situ investigation of works of art. The scientific approach used in situ is based primarily on imaging techniques that provide information on the elemental and crystal composition of materials and their structure (morphology and stratigraphy). Typically, elemental distribution images are determined with a custom-developed MA-XRF scanner that allows the measurement of both two-dimensional (flat scanning) and three-dimensional objects (rotational scanning) of medium/large size dimensions. Unique characteristics of this instrument include its fast-scanning modality, microscale resolution, high chemical sensitivity, and the ability to generate elemental distribution images of the sample on the fly. The MA-XRF scanner is usually combined with a custom-built MA-XRD scanner that allows for the further elucidation of the chemical nature of compounds and the oxidation state of materials in the same sample. Finally, non-invasive 3D mapping with confocal XRF provides information on the distribution of chemical elements over the thickness of the investigated object. This multimodal analytical approach, based on complementary techniques applied simultaneously to the same sample, provides more effective information on the nature of materials, manufacturing techniques, creative processes, and the presence of degradation products. Several relevant examples in wall, panel, and canvas paintings; manuscripts; and metallic objects are presented and discussed.



Θεματική Συνεδρία: Ανόργανα υλικά - Κεραμικά και υαλώδεις ύλες

Recent and advanced data from pyrometallurgical studies

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Abstract

Pyrometallurgical materials and artefacts that are pottery, clay, metal and glass, form the majority of the material that survives diachronically in sites of cultural interest.

The communication aims to shed light on recent studies and their characteristics based on published data; it is evidenced that this type of material forms the base of our understanding about material culture, status and transfer of technology.

Studies will focus on Aegean and mainly European excavated material and on non-destructive, non-invasive approaches.



Unlocking the secrets of glass bangles from Ierissos, Chalkidiki: Technological insights and provenance through SEM-EDS analysis

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Abstract

Glass bangles have been attested in the archaeological record since prehistory and continued to be produced during the Hellenistic and Roman period. Glass bangles gained the greatest popularity during the first millennium AD in central Europe and the Mediterranean. In the beginning of the second millennium AD, they were massively produced in the Middle East becoming object of trade between the East and the West. Many production sites have been recognized already in the Levantine coast, the Arabic peninsula, and the Persian Gulf.

Archaeological excavations at Ierissos in Chalkidiki brought to light a great number of more than 1000 glass bangles dating to the 11th - 12th c. AD. So far this is the richest assemblage of this type of glass excavated in Greece. In the absence of any glass working related evidence most likely this assemblage can be connected to imports which possibly was further distributed in the Balkans.

The main aims of this paper are to characterize the glass bangles from Ierissos, to group them according to their chemical composition and to understand their life cycle including any recycling events. To fulfil these aims, in the present study we investigated a subset of 80 objects from the Ierissos assemblage using SEM-EDS analysis. These glass bangles were made in a range of distinctive styles and colours and were classified typologically. Some are plain or have a plain core coated in coloured glass, others are decorated with twisted monochrome or/and polychrome cords, spirals, spots or trails. The data acquired with the SEM-EDS suggest interesting technological choices in the use of specific raw materials and first conclusions can be drawn upon the provenance of the raw materials and hence the origin of the glass.



Mycenaean Vitreous Artifacts: Overcoming Taxonomy Hurdles via Analysis

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Abstract

It is clear in the archaeological record that vitreous materials undergo significant degradation, which greatly distorts the visual appearance of artifacts. The corrosion state of an object plays a crucial role in its taxonomy, as the loss of the glassy state or glaze and the resulting optical effects render distinguishing glass from faience and other vitreous materials particularly difficult.

Resolving taxonomy issues related to vitreous artifacts is a demanding task due to the complex degradation mechanisms that directly affect their visual appearance and compositional fingerprint. Since their physical damage and alterations often lead to misclassification during retrieval and storage, it can result in further damage because of mismanagement, also likely leading to erroneous historical assumptions. Furthermore, it impacts the applicability of visual and compositional analysis, as well as the choice of conservation methods for stabilizing and preserving artifacts after recovery and poses challenges for archaeologists, conservation scientists, and archaeometrists in their efforts to study and interpret these materials effectively.

For this study, a collection of vitreous artifacts with varying preservation states from Mycenaean contexts in the Aegean region was examined. A state-of-the-art multi-analytical approach was adopted alongside established techniques (μ -XRF) to analyze, document, and identify specific compositional changes that occur due to degradation mechanisms within the surface layers. The primary objective of this study is to establish definitive connections between analytical data and the observed visual characteristics of the materials and corrosion layers under investigation.

Acknowledgements

The project is being realized within the framework of the 3rd Call of the Hellenic Foundation for Research and Innovation (HRFI) to support Postdoctoral Researchers.



Μικροσκοπικές παρατηρήσεις στην κεραμική του νεολιθικού οικισμού του Δισπηλιού Καστοριάς

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Περίληψη

Στο πλαίσιο του ερευνητικού προγράμματος ERC- EXPLOR «Εξερευνώντας τη δυναμική και τις αιτίες της αλλαγής χρήσης της γης κατά την Προϊστορική Εποχή σε μια κοιτίδα της ευρωπαϊκής γεωργίας» μελετήθηκαν 375 λεπτές τομές οι οποίες καλύπτουν όλες τις χρονολογικές φάσεις της Νεολιθικής περιόδου της αρχαιολογικής θέσης του Δισπηλιού Καστοριάς. Η ορυκτολογική μελέτη της κεραμικής συνδυάστηκε με τη στοιχειακή ανάλυση 101 δειγμάτων κεραμικής με τη χρήση χειροκίνητου αναλυτή φθορισμού ακτίνων Χ (pXRF) NITON XL3t GOLDD+. Στόχος της έρευνας είναι η αναλυτική μελέτη της τεχνολογίας της κεραμικής και της κινητικότητας της θέσης, σε σχέση με την ευρύτερη περιοχή του οικισμού.

Σύμφωνα με τη γεωλογία της περιοχής και τη δειγματοληψία ιζημάτων, αποδείχθηκε ότι οι κεραμικές ύλες προέρχονται από την ευρύτερη περιοχή του Δισπηλιού. Τα αποτελέσματα της πετρογραφικής ανάλυσης υπέδειξαν οκτώ ομάδες κεραμικών υλών για την κατασκευή των αγγείων, μεταξύ των οποίων κυριαρχεί η χονδρόκοκκη κεραμική ύλη με θραύσματα γνευσιακών πετρωμάτων. Η συγκεκριμένη κεραμική ύλη επικρατεί διαχρονικά στη θέση υποδηλώνοντας τη συνέχεια στη γνώση και τις συγκεκριμένες επιλογές των κεραμέων για εκατοντάδες χρόνια. Τα αποτελέσματα του pEDPXRf υπέδειξαν τον σχηματισμό έξι βασικών χημικών ομάδων οι οποίες χαρακτηρίζονται ως μη ασβεστιούχες και συνδέονται άρρηκτα με τις πετρογραφικές ομάδες. Η κεραμική παραγωγή στο Δισπηλιό χαρακτηρίζεται τοπική, με εμφανείς τεχνολογικές διαφορές στην κατασκευή ίδιων αλλά και διαφορετικών τύπων αγγείων.

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Archaeometric analysis of modern pottery from Kentri (Ierapetra, Crete) and its implications for the study of ancient ceramics: the case of the Minoan granodioritic pottery in the Isthmus of Ierapetra

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Abstract

Kentri is the easternmost traditional potting center in Crete; it is situated in the southern part of the Isthmus of Ierapetra, approximately 2.5 km from the modern city. The manufacture of pottery at the site began at the end of the 18th and flourished in the 19th and early 20th c., mainly due to the presence of suitable raw materials in the immediate vicinity. Production ceased in the mid 1980's, and unlike at the other centers of the island, there was no resurgence. Modern pottery sherds dispersed all around Kentri are the silent witnesses of this past potting activity. As part of a systematic surface survey in the plain of Ierapetra, the architectural remains of modern ceramic workshops were mapped, and modern pottery was collected and studied. Thin section petrography was applied in order to investigate the technological characteristics of the various types of ceramics. The work was complemented by the sampling and analysis of raw materials from the area, aiming at a holistic approach to the study of modern pottery production on a micro-regional scale. The analysis showed that the main fabric of the Kentri pottery is characterized by the presence of granodioritic inclusions, a lithology that is also predominant in the local raw materials.

In this paper we present the results of the analysis of the modern pottery and the raw materials from Kentri. Minoan studies have traditionally considered granodioritic pottery to be the product *par excellence* of the northern part of the Isthmus of Ierapetra and the Bay of Mirabello (hence the name "Mirabello fabric"). Our study attempts to challenge this prevailing assumption and offer an alternative source for the provenance of the granodioritic pottery.



Reaching the peak: Archaeometric analysis of pottery from the peak sanctuary of Philioremos-Gonies (north-central Crete)

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Abstract

The Minoan peak sanctuary of Philioremos-Gonies is located in north-central Crete, south-west of Herakleion. It was excavated in the 1960s by Alexiou and in the 2010s by Kyriakidis and displays all the characteristics of the genre: it is located on a peak, has visibility over a plain, and visual links with the nearby peaks of Keria-Krousonas, Pyrgos-Tylissos, Evgasos-Aidonochori, and others. It was most likely founded in the MM IB period, and a 3- or 4-room structure was erected sometime until the MM IIA period. The architectural remains reflect a significant investment in the building program of the sanctuary, which must have hosted ritual activities involving groups of people. This is further corroborated by the finds: a plethora of human and animal figurines, as well as architectural or other models, and a large amount of pottery sherds; the overwhelming majority of the latter belong to serving and drinking vessels, reflecting on-site consumption of food and drink, while some belong to shapes intended for small-scale storage and some to cooking pots.

The macroscopic study of the figurines and pottery identified two main classes of fabrics, one red non-calcareous, the other buff calcareous, both of which had several sub-categories. Petrographic analysis was applied on selected pottery and figurine samples in order to establish the range of fabrics encountered at the site and investigate their material properties, including mineralogical composition, texture, and manufacturing recipes. The project was complemented by small scale geological sampling and the analysis of raw materials collected in the area.

This presentation focuses on the results of the combined study of pottery typology and petrographic analysis; at an intra-site level we present the main fabrics used for the production of the coarse and fine wares, as well as the figurines, and we discuss their manufacturing technology and possible provenance. We also examine the position of Philioremos at a regional level: in this strategic area overlooking the plain and the routes leading from Knossos to Mount Ida at least three peak sanctuaries were founded at the same time, at a short distance from each other. Through the study of the pottery from Philioremos we attempt to shed some light on both the people who visited the site at a time of intense ritual activity on the peaks of Crete and the contemporary economic exploitation in the areas around these peaks.



Ceramic Production and Exchange Networks in Middle Bronze Age Attica

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Abstract

The primary objective of this presentation is to enhance our understanding of ceramic production and trade in Attica during the Middle Bronze Age (ca. 2.100-1.700 BCE), based on the evidence derived from the systematic excavations of the Department of History and Archaeology of the NKUA at Plasi (Marathon), the Belgian School on Great Velatouri (Thorikos, Lavrion), and the Agora excavations (Athens) of ASCA. The discovery of pottery kilns in Athens (Venieri 2010, 189) and Plasi (Kapsali 2019), along with the abundance of metal resources in the wider Lavrion region, suggests that these sites likely participated in a dynamic network of intercommunity exchanges within and beyond Attica. To gain further insights, we have employed a combination of quantitative analysis of macro-fabrics and wares, as well as the examination of 182 samples using ceramic petrography and chemical analysis, specifically employing Wavelength Dispersive X-Ray Fluorescence (WD-XRF) for the fine pottery.

Preliminary findings, particularly from the study of (semi-)coarse wares of presumably (broadly) local origin, reveal notable diversity in the clay pastes in Plasi and Thorikos, which likely stems from natural variations in the local resources and/or a decentralized household-based production model. This picture strongly contradicts with Athens, where more standardized clay recipes have been identified, samples of which were also recognized particularly at Marathon. Consequently, while Thorikos and Athens appear to be strongly integrated within the Argosaronic gulf network, which is predominantly influenced by Aegina, it is possible that the ties between Marathon and Athens were even stronger.

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Η εξέλιξη της χονδροειδούς κεραμικής στο ιερό του Καλαποδίου από τα τέλη της Μυκηναϊκής

Εποχής έως την Πρώιμη Εποχή του Σιδήρου: αρχαιολογικές προσεγγίσεις

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Περίληψη

Η παρούσα μελέτη παρουσιάζει τα αποτελέσματα της αρχαιολογικής και αρχαιολογικής μελέτης της χονδροειδούς κεραμικής (Jacobs-Felsch 1986· Nitsche 1987) του νότιου ναϊκού συγκροτήματος του ιερού του Καλαποδίου (Niemeier 2016, 303). Παρόλο που μελέτες και δημοσιεύσεις της συγκεκριμένης κεραμικής κατηγορίας υπάρχουν για αρκετές θέσεις της ηπειρωτικής Ελλάδας, είναι η πρώτη φορά που ένα τέτοιο σύνολο προέρχεται από ένα ιερό με συνεχή λατρευτική δραστηριότητα από τη Μυκηναϊκή έως και την Πρώιμη Εποχή του Σιδήρου (τέλη γεωμετρικής εποχής). Απώτερος στόχος αυτής της έρευνας είναι η εξέταση της τυπολογίας και του εύρους κατανομής των κατηγοριών της χονδροειδούς κεραμικής ανά χρονολογική φάση, και η σύγκριση των αποτελεσμάτων της αρχαιολογικής μελέτης με τα ανασκαφικά συμφραζόμενα και τα αποτελέσματα των αρχαιολογικών αναλύσεων. Ο συνδυασμός των τυπολογικών και των αρχαιολογικών αναλύσεων έδειξε αξιοσημείωτη συνέχεια αλλά και κάποιες ενδιαφέρουσες αλλαγές μέσα στο χρόνο ως προς τα σχήματα και την τεχνολογία κατασκευής αυτής της κεραμικής, οι οποίες παρουσιάζονται και συζητούνται στο πλαίσιο των γνώσεων που έχουμε για τη λατρευτική δραστηριότητα στο ιερό.

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Delos and its regional networks in the Hellenistic period

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Abstract

Macroscopic examination of Hellenistic ceramic materials from the Sarapieia on Delos as well as Sanctuary of Poseidon and Amphitria on Tinos showed that the same group of ceramics made in red-firing fabric is frequent on both islands. This group includes building materials, transport amphorae, cooking, utilitarian and table wares as well as lamps. In order to check the provenance of this group and to investigate the economic relationship between the islands, selected samples were subjected to thin section petrography and elemental analysis (WD-XRF). In addition, raw material prospection was undertaken on Tinos. The paper presents the results of integrated macroscopic and laboratory investigation, which indicated that Tinos is a potential source of this group. This has a great impact on studies of close-regional connectivity in the Cyclades, and especially on Delos because most research of pottery from this island has been focused on long-distance trade during the Late Hellenistic period.



Machine learning approaches in the interpretation of compositional data of archaeological ceramics collected with pXRF

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Abstract

Provenance studies of archaeological ceramics provide information about dissemination and trade of pottery and thus about economic and cultural relations of societies in antiquity. The provenance can be investigated with different analytical approaches based on the assumption that ceramics, manufactured at a specific place using specific raw materials can be distinguished according to their composition from ceramics manufactured at a different place. Elemental analysis of the ceramics is one of these approaches, which allows for distinguishing different ceramic categories and assigning pottery of unknown origin to known reference data of production sites. For the elemental analysis commonly laboratory methods with high precision and accuracy, such as neutron activation analysis (NAA) or wavelength-dispersive X-ray fluorescence spectrometry (WD-XRF), are selected in view of controlling analytical uncertainties, which otherwise might obscure small compositional differences. During the last 20 years, however, handheld portable XRF (pXRF) systems have been introduced in the study of archaeological materials allowing for non-invasive measurements of elemental compositions of a large variety of inorganic materials and providing prompt results. Particularly in the case of pottery analyses, though, several issues arise. The analytical precision and accuracy of pXRF is considerably lower compared to laboratory methods and the suite of elements, which potentially can be measured, is commonly smaller. Additionally, the method is extremely surface sensitive, which has to be taken into account for measurements of decorated, encrusted or weathered surfaces. This impedes the statistical evaluation of pXRF data of ceramics applying exploratory methods, which are commonly used for the evaluation of analytical data collected with laboratory methods. Because the pXRF data are considerably fuzzier their categorization requires a more flexible approach based on the actual data structure rather than on assumptions regarding geochemistry. For this, different machine learning approaches have been tested, such as supervised or unsupervised learning using artificial neural networks (ANN). The application of these approaches is demonstrated with different data sets and the resulting categories are compared with categories based on conventional exploratory multivariate data evaluation.



Colors on fire: reconstructing the change of color hues in firing of experimental ceramic briquettes

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Abstract

Color change is often used as a proxy for the mineralogical transformations occurring during firing of pottery firing according to their firing temperature. Thus, in this study we employed the non-destructive technique of Visible Near Infrared Spectroscopy (VNIR) in order to obtain a quantitative, fast and accurate color recording on experimental fired clay briquettes. These were prepared using clayey raw materials (n=58) collected from northern Peloponnese and western Greece (Corinthia, Achaia and south Epirus) and fired at 700, 900 and 1050°C, under oxidizing conditions aiming to use them as a comparative means for characterizing pottery from local archaeological sites and inferring about their suitability for ceramic manufacture. During previous studies undertaken under the framework of wider geoarchaeological research program the fired briquettes were characterised in terms of their chemical (XRF-WD) and mineralogical composition (XRPD) as well as some of their physical properties (such as their color using the Munsell Soil Chart). The calcareous character of the raw materials from western Greece and northern Peloponnese attested by means of WD-XRF and XRPD is well mirrored in the VNIR color recordings of the experimental briquettes, which tend to obtain light hues, such as pale yellow to darker hues, such as reddish brown. The results obtained so far show that the use of VNIR provide an alternative faster, more accurate, and reproducible approach which can automate color recording in likewise artefacts offering a higher throughput and a faster screening and grouping.



Preliminary study of Lesvos clayey raw materials: a pXRF analysis

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Abstract

Over the last years several archaeological and ethnographic studies have been focussed on the investigation of pottery production in the East Aegean and Asia Minor (Hein et al., 2008; Zachos et al., 2010). However, the determination of the origin of production of specific pottery wares particularly on the island Lesvos turned out to be a complex topic due to huge variety of available raw materials and the numerous places of production through time. The present study focuses on examining the compositional variation of local clayey raw materials potentially used for pottery production in Lesvos taking into account their suitability for pottery production. After a detailed literature review concerning the archaeological, geological and ethnographic background of the area a field survey of clayey raw materials was undertaken. During the field survey 23 deposits were identified in different island locations, wherein sampling of 39 clayey raw materials took place. Most of the samples were collected near ancient and historic cities such as Mitilini, Mithimna, Antissa, Arisvi, Eresos, Pyrrha. The samples were cleaned and experimental briquettes were prepared and fired (700°C, 900°C, 1050°C) at a laboratory furnace. The elemental composition of the briquettes was examined with a NITON XL3t GOLDD+ portable handheld XRF system (pXRF) at NCSR Demokritos. Preliminary results indicate two large compositional clusters with a clear difference in calcium oxide (CaO) content. The first cluster includes samples from areas such as Agiasos and Mistegna with a comparably high CaO content (7-20wt%), while the second cluster contains samples from areas such as Mandamado, Mesotopos and Arisvi with a significantly lower CaO content (<4wt%). In the first cluster the samples from Agiasos (1st sub-cluster) present few compositional differences in comparison to those of Mistegna (2nd sub-cluster). In the second cluster Mandamado samples show a clear distinction from those of Mesotopos, Arisvi, Skoutaros or Filia. The pXRF provides a first preliminary categorization of the raw materials as part of a larger project, which includes the analysis of the experimental briquettes with different techniques such as optical microscopy (O.M) and XRPD. Nevertheless, allowed for a straightforward screening and grouping and thus offering a first sight of the material. A petrographical and mineralogical analysis will follow and complete the research.

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Θεματική Συνεδρία: Ανόργανα υλικά – Μέταλλα

Χημική ανάλυση χάλκινων αντικειμένων της Πρώιμης και Μέσης Εποχής του Χαλκού από τη
βόρεια ακτή της Κύπρου

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Περίληψη

Η βόρεια ακτή της Κύπρου ήταν μια ιδιαίτερα εμπορικά ενεργή περιοχή ήδη από τα τέλη της Πρώιμης Εποχής του Χαλκού (2250-1950 π.Χ.). Στη συγκεκριμένη περιοχή εντοπίζονται τα πολύ σημαντικά νεκροταφεία στις θέσεις Μπέλαπαϊς *Βουνοί* (Stewart and Stewart, 1950) και Λάπηθος *Βρύση του Πάρπα* (Gjerstad et al., 1934; Webb, 2020), με ιδιαίτερα πλούσιες ταφές, τόσο της Πρώιμης όσο και της Μέσης Εποχής του Χαλκού. Οι εκτεταμένες ανασκαφές στα δύο νεκροταφεία, που διεξήχθησαν κυρίως κατά το πρώτο μισό του 20^{ου} αιώνα, έφεραν στο φως έναν πολύ μεγάλο αριθμό χάλκινων αντικειμένων, τόσο τοπικής όσο και εισηγμένης προέλευσης και τεχνοτροπίας. Η μελέτη των χάλκινων αντικειμένων από τους κύριους οικισμούς της βόρειας ακτής της Κύπρου (Βασιλία, Μπέλαπαϊς, Κάρμι, Λάπηθος) εντάσσεται στο πλαίσιο του ερευνητικού προγράμματος **North Coast Metals**, το οποίο χρηματοδοτείται από το Πανεπιστήμιο Κύπρου. Κύριος στόχος του προγράμματος είναι η ταυτοποίηση των κραμάτων που χρησιμοποιήθηκαν στην κατασκευή των χάλκινων αντικειμένων της Πρώιμης και Μέσης Εποχής του Χαλκού που έχουν ανασκαφεί σε αρχαιολογικές θέσεις της βόρειας ακτής της Κύπρου. Η παρούσα ανακοίνωση εστιάζει στα αποτελέσματα της μη-καταστρεπτικής χημικής ανάλυσης (handheld XRF) των χάλκινων αντικειμένων από τις θέσεις Μπέλαπαϊς *Βουνοί* και Λάπηθος *Βρύση του Πάρπα*. Η ανάλυση καταδεικνύει την εκτεταμένη χρήση του κράματος του αρσενικού χαλκού (Cu-As) και στις δύο θέσεις, καθώς και την έντονη παρουσία του κασσιτέρου, στοιχείο που δεν εντοπίζεται στη γεωλογία του νησιού, για την παραγωγή κραμάτων μπρούντζου (Cu-Sn), κυρίως στην περίπτωση της Λαπήθου. Ιδιαίτερο ενδιαφέρον παρουσιάζει και η περίπτωση του μολύβδου (Pb), στοιχείο το οποίο επίσης δεν εντοπίζεται στα χαλκούχα μεταλλεύματα της Κύπρου, και έχει καταγραφεί σε αντικείμενα και από τις δύο θέσεις, υποδηλώνοντας πιθανές επαφές με άλλες περιοχές της Ανατολικής Μεσογείου. Τέλος, σημαντικό αποτέλεσμα της χημικής ανάλυσης αποτελεί η διαπίστωση πως συγκεκριμένοι τύποι κράματος επιλέγονταν σκόπιμα από τους μεταλλοτεχνίτες για συγκεκριμένους τύπους αντικειμένων.

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The “lost city of copper”? Copper production at Enkomi: a study of metallurgical ceramics.

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Abstract

Enkomi, which is located in the east coast of Cyprus, is considered to be the most important settlement of the Late Bronze Age. The excavations at Enkomi, especially those directed by Dikaios in the mid 20th c. in the northern edge of the town, revealed evidence of a buzzing metallurgical industry dating already from the earliest phases of the settlement's occupation¹. The presence of workshops within the urban environment of Enkomi and at a significant distance from the rich ore deposits of the Troodos Mountains triggered multiple discussions regarding the organisation of the metal industry and the *chaîne opératoire* for the production of the prominent Cypriot copper ingots and their distribution across the Mediterranean.

Nevertheless, the metallurgical assemblage (refractories and slag) has not yet been studied thoroughly with the exception of a very small number of slag samples. The current project focuses on the technical ceramic assemblage found in Area III. Chemical (bulk and spot) and mineralogical examination has been conducted on the material with the aim to reveal the metallurgical operations taking place in the northern part of the city. The results of the analyses have shown that during the long habitation history of Enkomi the copper workshops at Area III are occupied with the same metallurgical operations. Interestingly, small technological variations detected ought to be ascribed to cultural and technical factors. To understand the significance of our results, comparisons have been made with the limited generated data from contemporary metallurgical ceramic assemblages. It is then when the leading position of Enkomi in the LBA Cyprus was corroborated by archaeometallurgical evidence.

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Accidental or Intentional?

The Practice of Early Copper-alloying with Arsenic in the Aegean

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Abstract

Following a tendency known from most regions of the Old World, arsenical copper has been proven to be the dominant Cu-based alloy in the Aegean during the 3rd millennium BC. However, the technological path(s) by which these alloys were produced remain unresolved, and it is still unclear whether the practice of producing arsenical copper was a technological choice or resulted from an accidental pyrotechnological event. Secondary copper mineralization, as well as arsenic-bearing occurrences can be found at a number of sites^{1,2} in Greek mainland and the Aegean islands. Evidence about early local production of arsenical copper is presented in this paper.

The early production of arsenical copper from three areas or sites directly associated with this alloy is the subject of the present study. They are: 1) the site of Chrysokamino in Eastern Crete, where minute fragments of unsmelted ore, escaped from the furnace, clearly show that copper and arsenic coexisted paragenetically and constituted the main metalliferous raw material, 2) the island of Keros, where a recently analysed copper ingot, coming from an old excavation of Prof. Ch. Doumas, exhibited an arsenic content of well over 3%, so that it actually consists of a Cu-As alloy and 3) southern Kythnos, from where two, currently being studied, copper ingots appear to be As-containing.

For the seeking of examination of the above issues, we highlight the specific importance of a Cu-As mineralization consisting of conichalcite, $[\text{CaCu}(\text{AsO}_4)(\text{OH})]$, discovered at Koutalas in southern Seriphos². Moreover, we take into account the analyses of Cu-based ingots from the sunken hoard of Mesi and Glyfada (in north Aegean/Thracian Sea) that exhibit a slightly elevated arsenic content.

Finally, we examine the technological query of whether early Aegean arsenical-copper production consisted of one or two-stage operation. Based on the available data, we rather accede to the view that both approaches might have been followed. However, this would have depended on the raw materials available at the time.

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Assessment of Erosion Risk for Metallurgical Slags on Agios Sostis Peninsula, Siphnos Island

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Abstract

Aghios Sostis Peninsula on Siphnos Island holds invaluable insights into our historical past. This site, renowned for its rich metallurgical slag deposits, serves as a testament to ancient mining and smelting practices. However, the preservation of these deposits is under constant threat from both human activities and natural erosive forces.

Our research is dedicated to assessing and modeling erosion risks specifically concerning the loss of ancient metallurgical slags on the Aghios Sostis Peninsula. The depletion of slag deposits is a consequence of various factors, including unauthorized collection and natural processes like rainfall and runoff that transport slags towards the sea. To quantify the extent of slag loss, we adapted the well-established Soil Loss Equation, taking into account parameters such as rainfall erosivity, soil erodibility, slope characteristics, and vegetation cover. This adaptation enables us to estimate potential slag material loss over time and predict future erosion patterns.

The outcomes of our study shed light on the vulnerability of the Aghios Sostis Peninsula to erosion, facilitating the development of effective strategies to mitigate these risks. The unique topographical features of the peninsula and its proximity to the coastline make it especially susceptible to intense rainfall and runoff, leading to significant slag losses.

Understanding the underlying erosive processes permits to develop strategies for safeguarding the remaining slag deposits, ensuring their availability for future research and cultural heritage preservation. Our work points out the critical importance of integrating scientific research, archaeological conservation efforts, and land management practices. Collaborative initiatives with local stakeholders are vital for ensuring the long-term sustainability and protection of Aghios Sostis cultural heritage site.



New data on the metallurgical production on western Siphnos

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Abstract

In this paper, the metallurgical finds discovered during the survey conducted on western Siphnos by the Ephorate of Antiquities, as part of the project “Siphnos and beyond”, will be presented. Currently, our knowledge concerning the metallurgical production on Siphnos is confined to the eastern and southern part of the island, where the major prehistoric argentiferous lead mining site of Agios Sostis and lead-silver and copper production sites, like Akrotiraki, Kasela and Skali, are located. During the survey, four main sites with metallurgical remains were revealed in the areas of Krina, tou (Nt)zioti to Petali and Katzouraina, whilst similar finds have been located scattered in other locations. The finds include litharge fragments, slag and furnace wall fragments. Although the surface finds cannot be dated securely, the type of the furnace wall fragments resembles similar finds from other Cycladic islands that have been dated in EBA. In order to identify the type of the slag fragments and the slag attached on the furnace wall fragments, 30% of the finds per site were analysed with p-XRF. The analysis revealed that the production is related to both lead-silver and copper smelting. It is rather interesting that there is a typological difference between the lead- and copper-production related furnaces, regarding the existence of perforations, a pattern that has been noticed at sites on southern Siphnos. As far as copper production is concerned, the only securely currently known site is Skali on southern Siphnos. At the same time, the exact mining site of copper ore is currently unidentified, whilst the new finds rise questions related to its location. Under the light of the above new evidence, it becomes clear that metallurgical production is not restricted to the eastern and southern part of the island, but it is rather an activity well dispersed and well known on Siphnos.



Early Bronze Age silver production on southern Sifnos: the sites of Kasela and Akrotiraki

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Abstract

This paper presents the results of the archaeological and archaeometallurgical investigation of the metallurgical finds from the smelting site of Kasela and the settlement of Akrotiraki, on southern Sifnos. Currently, our knowledge of silver-lead exploitation in the prehistoric Aegean is rather restricted. No other prehistoric smelting site has been identified, except for Agios Sostis on Sifnos, which is, though, mainly a mining site, whilst in Cyclades only sporadic finds of litharges, related to cupellation have been identified. This presentation aims to a better understanding of the chaîne opératoire of the Early Bronze Age silver production, by studying, for the first time, evidence of all stages as a whole. To a second level, this paper aims to shed light into organisational and social aspects of the silver production and thus into the exchange routes and their influences on the Early Bronze Age Aegean societies. The metallurgical remains under study include lead slag, litharge fragments, furnace wall fragments and sherds with lead oxide attached. The main analytical techniques that are implemented in this research include Optical Microscopy and SEM-EDX analysis. The analytical examination of the smelting slags from Kasela and the lead slags from Akrotiraki revealed high amounts of antimony and zinc, which suggest a local ore source, whilst some of the lead prills contain small amounts of silver and copper. However, the macroscopical differences between the slags of the two sites, could suggest that they derive from different stages of the production. The majority of the litharge fragments from Akrotiraki are in the shape of shallow bowls. The presence of siliceous material within the samples suggest that they are rather litharge impregnated hearth lining (Pernicka et al. 1998). The existence of metallic silver within those fragments confirms their correlation with silver production.

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Το μυκηναϊκό σύστημα *ta-ra-si-ja* και η συμβολή των αρχαιολογικών αναλύσεων στην κατανόησή του

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Περίληψη

Βασικό χαρακτηριστικό της βιοτεχνικής παραγωγής κατά τη Μυκηναϊκή ανακτορική περίοδο (1400-1200 π.Χ.) ήταν το σύστημα που καταγράφεται στις πινακίδες της Γραμμικής Β γραφής ως *ta-ra-si-ja*. Μέσω αυτού, το μυκηναϊκό ανάκτορο έλεγχε την παραγωγή, καθώς φαίνεται να παρέδιδε συγκεκριμένες ζυγισμένες ποσότητες πρώτων υλών, συμπεριλαμβανομένων και μετάλλων, σε ειδικευμένους τεχνίτες με σκοπό την επιστροφή τους στο ανάκτορο με τη μορφή ολοκληρωμένων τεχνέργων αντίστοιχου βάρους.

Ωστόσο, η κατανόηση της *ta-ra-si-ja* παρουσιάζει κάποια κενά. Πρώτον, είναι γνωστό μόνο από επιγραφικές μαρτυρίες (Γραμμική Β), χωρίς επαρκή, μέχρι τώρα, επιβεβαίωση από αρχαιολογικά δεδομένα. Δεύτερον, οι σχετικές με τα μέταλλα πινακίδες, προέρχονται αποκλειστικά από το ανάκτορο του Επάνω Εγκλιανού (Πύλος), και χρονολογούνται στα τελευταία χρόνια της λειτουργίας του, λίγο πριν την οριστική καταστροφή (1200 π.Χ.). Επομένως, θα μπορούσε, θεωρητικά, να πρόκειται για ένα έκτακτο σύστημα ελέγχου της παραγωγής, που διαμορφώθηκε ως απόκριση στις κρίσεις των τελευταίων χρόνων του ανακτορικού συστήματος, και όχι ένα οργανωμένο σύστημα ανακτορικού ελέγχου της παραγωγής κατά την περίοδο της μέγιστης ακμής του.

Αντικείμενο αυτής της παρουσίασης είναι η επαναπροσέγγιση των παραπάνω προβλημάτων υπό το φως υφιστάμενων αρχαιολογικών αναλύσεων για τη σύνθεση των κραμάτων κασσιτερούχου χαλκού κατά την Υστεροελλαδική IIIA περίοδο (14ος αι. π.Χ.) στην περιοχή της Πυλίας. Οι αναλύσεις έχουν δείξει αξιοσημείωτη σταθερότητα και τυποποίηση στους τύπους των κραμάτων και στις τεχνικές κατασκευής, η οποία έρχεται σε αντίθεση με την ποικιλομορφία των πρωιμότερων φάσεων.

Σκοπός της μελέτης είναι, αφενός, η παρουσίαση των τεχνολογικών χαρακτηριστικών και της εξέλιξης της μυκηναϊκής μεταλλοτεχνίας, αφετέρου η πιθανή σύνδεσή τους με την ανάδυση των μυκηναϊκών ανακτόρων και τον έλεγχο της παραγωγής μέσω του συστήματος *ta-ra-si-ja*. Τα αποτελέσματα των αρχαιολογικών αναλύσεων χρησιμοποιούνται όχι μόνο ως ισχυρή ένδειξη για την ύπαρξη του συστήματος *ta-ra-si-ja*, αλλά και μας επιτρέπουν να ανάγουμε την εμφάνισή του συστήματος στις απαρχές της ανακτορικής περιόδου, ως αναπόσπαστο τμήμα μιας ανακτορικής προσπάθειας ελέγχου της παραγωγής, και όχι ένα έκτακτο μέτρο των χρόνων πριν την τελική καταστροφή.



New data on the mining process at Lavrion

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Abstract

The Lavrion mining district in southeast Attica in Greece has hundreds of ancient underground mines, vertical shafts, opencasts, mining debris, and establishments for metallurgical processes such as washeries and furnaces. Field investigations during the last five years within the framework of four research projects have provided considerable new data on ancient mining processes. During the “Lavrion shafts project” in 2018, vertical mining shafts were located, recorded, and mapped geologically and topographically. A further representative selection of horizontal mines was mapped and ore samples obtained during the ERC SILVER project from 2019 to 2021, producing high-precision lead and silver isotope data. Ancient tools found in the broader area of Lavrion during the 19th century by the French Mining Company (hammers, chisels, axes, crowbars, cuffs), now exhibited in the Archaeological Museum of Saint-Germain-en-Laye in Paris, were also studied, providing new information about equipment and techniques in use at the time, as well as underground mining conditions.

To complement the work of the earlier research projects, parts of the underground system were mapped in detail and the different phases of exploitation of the silver-bearing minerals recorded using the laser meter DISTO-X. A 3D model of the mining works and their exploitation phases was produced, shedding new light on the silver extraction process at the rock interfaces of Lavrion stratigraphy. Our new data reveal the diachronic exploitation of galena and other silver-bearing minerals along an extended vein network. Integration of this wide array of new information from these investigations has contributed to a better understanding of ore extraction from the ancient miner’s perspective and methods of operation.



Preliminary pXRF analysis on silver coins from ancient cities of Aegean Thrace

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Abstract

The introduction of minting among the ancient cities of Aegean Thrace appears at an early date, i.e. second half of the 6th c. BC, just after their foundation from Ionian cities. Those earlier issues were made by electrum and silver. Thus, the early coinage of Abdera, Dikaia, Maroneia, and Ainos are important as they provide direct clues on the access these cities had to the rich and well-known precious metals deposits of the Thracian region. By examining the chemical composition of silver issues from different cities of the region and comparing them as per chronological phase, our target is to evaluate the purity of silver acquired in each case and how this might have changed over time during Classical and Hellenistic times.

A total of 96 silver coins from several cities of Aegean Thrace have been analysed using a pXRF (Bruker Tracer 5g) providing information on their elemental composition. The results show that apart from Ag, most of them contain various amounts of Cu, Pb, Au and in rarer cases lower contents of Pt. Impurities such as Fe and Ti are rare and have been detected in a limited number of coins. Cu is present in contents between 1 and 10% with the majority in the 3-5% range, and a smaller group of coins with contents below 1%. Pb contents range between 0.3 and 2%. The Ag/Au correlation shows that the majority of coins contain Au in concentrations below 1% with the largest grouping in the 0.25-0.50% region with only one outlier. The results are in accordance with previous geological/geochemical studies confirming that some of the silver-bearing deposits of Thrace contain low Au contents (Voudouris et al. 2011; Melfos and Voudouris 2017). Issues of procurement of raw materials are being discussed in light of the current analytical results.

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The numismatic heritage of Rhodes: insights from microscopic X-ray fluorescence (μ -XRF) analyses of copper and silver alloy coins from the 4th century BCE to the 2nd century CE

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Abstract

The analysis of 111 copper-based and 11 silver alloy coins from the ancient city of Rhodes, Greece, yielded new data corroborating our understanding of the numismatic heritage of Greece. For the first time to date, a comprehensive elemental analysis has been conducted on copper-based coins produced by the Rhodian mint and spanning the mid-4th century BCE towards the 2nd century CE. The results of the μ -XRF analyses revealed three distinct groups of copper alloys, with tin and lead being the most important alloying elements. The elemental composition clearly portrays the predominance of binary, leaded, and ternary bronzes in the majority of the coins, while two samples - confirmed as imports - belong to a different technological tradition. The presence of impurities such as iron, nickel, cobalt, antimony or lead is typical of copper ores, while the diminutive amounts of tin, lead and/or arsenic in some coins could indicate that they were made of copper scrap alloys.

Using silhouette analysis for K-means clustering, we identified four distinct groups that were clustered based on similar trace element values from a complex and extensive set of compositional data. The groups not only provide valuable insight into Rhodian coin production, but also provide indications of the raw materials used for minting.

In the case of silver coins, four groups of different silver grades can be distinguished based on the major alloying elements. Despite the differences in the composition of the silver coins, a larger sample would be needed to gain a more comprehensive understanding of the evolution of Rhodian silver coinage.

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Ancient iron objects from the Sanctuary of Zeus Parnessios.

Smithing the archaeometallurgical information

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Abstract

The material for this study comes from the excavation conducted in 1959, in a cave on the summit of Parnitha, the highest of the three mountains of Attica which from the limited until now study of the findings, seems to have had a religious function, and was dedicated to Zeus, with artifacts dating, based on the pottery, from the Late Geometric to the Late Archaic Period.

Among the finds, there are more than four thousand iron objects, mostly knives of various sizes and types as well as a significant number of spits (obeloi) and seven Naue II swords. In addition to their large number, the iron objects are of particular interest because of their very good state of preservation, covering at the same time a wide chronological range of more than three centuries, that are, in fact, the very first centuries of the development of iron metallurgy and metalworking in Greece.

The archaeometallurgical study of the material and the multi-analytical approach used, within the framework of a recently completed doctoral thesis, to study iron technology (smelting, smithing, mechanical and thermal treatment), shed light on many largely unknown aspects of the Early Iron Age.

The presentation focuses on the results of the analyses of two specific knives with an unusually high percentage of nickel, giving rise to a new debate regarding the deliberate smelting iron from laterites, during the early phases of the Iron Age.



Late Bronze Age gold artefacts from Kalapodi, Phthiotis, Central Greece: preliminary results

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Abstract

The present announcement deals with the preliminary results of analyses conducted on a specific collection of gold artefacts originating from Late Helladic IIB - IIIA chamber tombs that were excavated by Sofia Dimaki at Kalapodi, Phthiotis, Central Greece. The artefacts were initially examined at the Archaeological Museum of Atalanti by means of a portable X-ray fluorescence spectrometer (pXRF) for the determination of the gold alloy type that was used for their production. In the interest of defining the proportion of the components which form the gold artefacts as well as identifying traces of manufacturing processes analysis was conducted under a Scanning Electron Microscope coupled with an Energy Dispersive X-ray spectrometer (SEM-EDS) at the Laboratory of Palaeoenvironment and Ancient Metals Studies, of the Institute of Nanoscience and Nanotechnology, National Center for Scientific Research "Demokritos" in Athens. The examination of the artefacts revealed a gold alloy consisting of a high percentage of silver with lesser amount of copper. The analytical results that have been obtained so far are presented in this announcement aiming to enhance our knowledge in Mycenaean goldworking techniques in this specific region and in Central Greece in general.



***Epitaphioi* from Vatopediou Monastery at Mount Athos and the Ecumenical Patriarchate of**

Constantinople: advancements in manufacturing technology or just luxurious?

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Abstract

This study presents the investigation of metal threads construction technology of two Orthodox liturgical textiles called *epitaphioi* from Vatopediou Monastery at Mount Athos and the Ecumenical Patriarchate of Constantinople through the OM, X-Ray and Scanning Electron Microscopy (SEM-EDS). The first case study textile is an 17th century *epitaphios* that was founded after decades underneath the altar of the main Church (*Katholiko*) of Vatopediou monastery at Mount Athos. In the center Christ is depicted, reclining on a marble altar, while his head is supported in the arms of the Virgin who is kneeling at the side and bent towards him.

The second case study textile is an 18th century *epitaphios* constructed possibly in a Constantinople workshop and nowadays is displayed in the main Church of the Ecumenical Patriarchate of Constantinople. The item is an embroidered textile and is one of the few surviving embroidery examples in Constantinople. The main central scene is stitched to a hard paper backing attached to a red velvet surface by satin or flat stitches. The figures are in padded relief and executed in as the whole main scene with metal threads. The style of the figures imitates Byzantine models using conventions of local workshops in the Greek style.

The aim of this study was mainly to highlight the contribution of the OM, X-RAY and SEM-EDS for identifying the potential technological development in manufacturing of metal threads or the potential preference for more luxurious artifacts that existed in different chronological periods. Different metal alloys with different metal construction practices were observed after the application of OM, X-RAY and SEM-EDS. Did they prefer precious metal alloys with the main metal element Au or Ag? Did they use platina with precious metals on low-cost metal core and how the metal parts were adapted to the natural fibers?

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Θεματική Συνεδρία: Βιοϋλικά και οργανικά κατάλοιπα

Analytical methods and digital applications in the study and exhibition of human skeletal remains

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Abstract

Anthropology, and especially the fields of paleogenetics, palaeodiet and imaging technologies have reached an unprecedented number of discoveries over the last years. Ancient DNA, isotopic research, as well as 3D digitization provide information on nutrition, health, physical stress, demographic and anthropometric characteristics, contributing to the reconstruction of the socio-cultural and biological parameters of ancient populations. At the same time, the technological advances in the areas of virtual and augmented reality and 3D printing, offer the opportunity to exhibit human skeletal remains through novel applications. It is possible, therefore, to introduce innovative solutions for the promotion of this important archaeological finding with scientific validity and proper dissemination. These solutions are based on the synergy of archeology, anthropology, natural sciences and stakeholders from culture and tourism ensuing an important economic benefit for both public and private sector.



METAMOBILITY: Meta-analysis and agent-based modeling of human mobility in the Graeco-Roman world

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Abstract

This presentation will focus on the MetaMobility project, the objective of which is to explore the nature and impact of human mobility in the Graeco-Roman world, focusing on the Hellenistic and Roman Eastern Mediterranean. To achieve this objective, MetaMobility integrates published human osteoarchaeological, zooarchaeological, archaeobotanical, economic and social historical data and tests alternative mobility scenarios via agent-based modeling. The bioarchaeological data come primarily from published information in journals and grey literature, but also from original data generated by our team members in Central and Eastern Mediterranean (Greece, Cyprus, Lebanon, Italy), showcasing the importance of maximizing the use of legacy data while also engaging in original data collection. The results of the project currently include open access bibliographic databases for published osteoarchaeological, zooarchaeological, and archaeobotanical studies in central and Eastern Mediterranean, such as Bi(bli)oArch (<https://www.biblioarch.com/>) and Bi(bli)oArch-Italia (<https://italia.biblioarch.com/>), while similar initiatives for zooarchaeology and archaeobotany are currently under preparation. In addition, MetaMobility has thus far offered important insights to Graeco-Roman mobility along the Phoenician coast during Roman times, focusing on Tyre, Beirut, and Byblos. The biodistances within and between these three human skeletal assemblages showed that Tyre and Beirut were more heterogeneous than Byblos. In addition, inter-assemblage biodistances supported a relative proximity between Tyre and Beirut, followed by some affinity between Beirut and Byblos. In contrast, Tyre and Byblos were very divergent. This pattern agrees with historical sources and literary texts that support that Beirut and Tyre, as key Roman colonies and commercial hubs in the Eastern Mediterranean, had high levels of mobility when compared to other coastal cities such as Byblos. MetaMobility team members are additionally currently exploring mobility patterns in Hellenistic Sicily and Classical to Roman mainland Greece, while we are also compiling information on economy and environment in order to contextualize the mobility patterns.



A spatiotemporal study of population continuity and discontinuity in central Greece during Classical and Hellenistic times through biodistance analysis.

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Abstract

During the Classical and Hellenistic periods mainland Greece was characterized by major historical events that shaped the Graeco-Roman world. The tumultuous history of the area is characterized by a series of great wars, the formation of alliances and city-states, as well as economic and cultural prosperity and decline (Hansen 2006). Boeotia held an active role to the aforementioned events, while its capital, Thebes, was one of the main powers in the area until its destruction by Alexander the Great in 335 BCE (Buckler 1980). Macedonian troops inhabited the area until its occupation by the Romans in the 2nd c. BCE. The aforementioned events had a great impact on the people inhabiting the area, causing population dislocations as attested in historical sources. For example, after the destruction of Thebes, the population fled to the adjacent city of Akraiphia as well as in Athens, and some returned after the city was rebuilt by Kassandros 20 years later (Papachatzis 1981). As such, the area and period under study present an ideal setting to examine population mobility. The current paper examines biodistances using dental nonmetric and metric data. Intra-cemetery biodistances are used to assess biological kinship patterns and the degree of heterogeneity within Thebes and Akraiphia during Hellenistic and Roman times, while inter-site biodistance analysis aims at elucidating the degree of gene flow between these two Boeotian cities in each of the above periods. Therefore, human mobility is explored at different resolutions (from pairwise individual distances to broader cemetery populations) and at different temporal and spatial scales.

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Exploring Ancient Infant Weaning: Leveraging Machine Learning and Bayesian Modelling on Stable Isotope Data from Dentinal Collagen

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Abstract

Stable isotope analysis is a widely used technique for reconstructing palaeodiet. By measuring isotope ratios from collagen in tooth microsections, it is feasible to gain detailed insights into human diets throughout childhood and adulthood. However, much of the analysis is currently performed manually, making it time-consuming, labour-intensive, and prone to errors. In this study, we propose a streamlined and automated methodological suite of statistical analyses to investigate personalized aspects of weaning using incremental dentine data. Our sample population consists of 780 stable isotope measurements (nitrogen and carbon stable isotope data) from 66 individuals from ancient Thessaloniki, one of the first ancient urban centres in South-eastern Europe, mostly dated between 168 BC–323 AD. To estimate weaning duration, we developed a unique mathematical tool that utilizes serial stable nitrogen measurements from first permanent molars (Ganiatsou, Souleles, and Papageorgopoulou 2023). Additionally, we applied Bayesian modelling to estimate the relative proportion of breast milk during the weaning process. Furthermore, we employed the k-means algorithm to identify patterns of physiological stress using carbon and nitrogen ratios. Our combined approach has revealed that an automated method for studying ancient infant feeding can be established and yielded notable information with unprecedented accuracy. We found that the duration of weaning did not correlate with the proportion of breast milk, suggesting an abrupt discontinuation of breastfeeding rather than a gradual reduction in its frequency. Additionally, the application of the k-means algorithm identified a distinct cluster of individuals who exhibited isotopic evidence of stress during and after the weaning process. This study introduces novel approaches for analysing isotopic data and demonstrates the integration of machine learning and Bayesian modelling techniques in bioarchaeological research. By applying these methods, we gain valuable insights into the feeding strategies and cultural dynamics of ancient societies.

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Echoes, an interdisciplinary reconstruction of life in ancient Thessaloniki

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Abstract

Urban areas are places where architecture, material culture, and the organization of space, reflect their history. The reconstruction of the historical past of cities brings to light specific features of past societies. We propose a methodology for highlighting the human past of Thessaloniki, through a key factor of social expression, the biographies of its inhabitants. We study the human remains and the associated findings of material culture from the excavations during the construction of Thessaloniki's metropolitan subway. By integrating scientific innovations and cutting-edge technologies, such as ancient DNA, isotopic analysis, 3D scanning, virtual (VR), and augmented (AR) reality, we reconstruct the biographies of everyday and exceptional individuals. Through the cooperation of academic and cultural institutions with companies in the sector of creative industries, we develop alternative narrations of the city's history and experiential tours. Our research project aims to preserve the memory of the transformed urban landscape of Thessaloniki and attract interest in the city's multicultural and diachronic character.



Urban bioarchaeology of Thessaloniki. A biosocial analysis of the skeletal material excavated during the construction of the metropolitan subway

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Abstract

Urban bioarchaeology provides context and theoretical background for studying human skeletal adaptation to urban environments. The reconstruction of past lives by multidisciplinary approaches has become an active topic in the field. Our study integrates a toolbox of bioarchaeological methodologies, aiming to explore how the urban environment impacts the living conditions of the population in ancient Thessaloniki. It is well known that the city, due to its strategic position, turned into a significant economic-political hub and a multicultural metropolis, continuously retaining its urbanity. We analyzed the human remains excavated during the construction of the city's metropolitan subway, spanning from the Hellenistic (323 BC) to the early post-Byzantine period (15th c AD). We investigated population differences among chrono-cultural groups through the morphological variation of the temporal bone of the skull. The geometric morphometric analysis shows a separation of the Hellenistic in relation to the Roman population. These results are consistent with historical and archaeological sources that support population influx. We also studied the living conditions of inhabitants through skeletal indices of stress including stature, body mass, linear enamel hypoplasia, and cranial trauma. Regarding body size, the analysis of variance (one-way ANOVA) shows no significant differentiation from Hellenistic (163.1 cm / 65,5 Kg) to Roman (162.9 cm / 64,2 Kg) and then to the Byzantine (161.6 cm / 62,7 Kg) and early Post-Byzantine (161.2 cm / 66,5 Kg) periods. The frequency of enamel hypoplasia shows a secular increase from the Hellenistic (46.9%) to early Post-Byzantine (74.15%) years. Most of the traumas (62%) were observed on the left side of the skull and above the hat-brim line, maintaining that these injuries are more likely due to interpersonal violence. Our study points out the significance of ancient humans as central agents in archaeological narratives.



Investigating food practices and cultural hybridity in the ancient Greek colony, Ambracia using Stable isotopes ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) and Bayesian Mixing model.

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Abstract

The coexistence of multiple traditions in the newly formed Ancient Greek colonies led to a cultural hybridization allowing nutritional systems to combine in new ways. The relationships between the mother-cities and colonies were profitable for both entities, and in some cases, the colonies preceded the motherland in terms of cultural and political developments. Within this context, the reconstruction of past diets can highlight these interactions, as food in ancient Greece was regarded as a marker of culture. In this study, we utilise stable carbon and nitrogen analysis of human and faunal remains together with isotopic mixing models to quantify the relative contribution of different food sources in Ambracia, a Corinthian colony. We examine the individuals' diet to clarify food strategies during the colonization process. A diet of 232 individuals and 17 animals was reconstructed by measuring nitrogen and carbon isotope ratios on bone collagen. The material originates from the western cemetery of ancient Ambracia dated from its foundation (625 BC) to the city's decline (33 BC). Dietary protein was estimated using the Bayesian mixing model MixSIAR, published isotopic values and fractionation offsets.

Our results demonstrate that the first settlers and subsequent generations followed the same diet, consisting mainly of terrestrial animals and a lesser extent of C3 plants (grains, cereals, fruit-vegetables) and marine resources (fish-seafood). During the Hellenistic period (323-31 BC), in which Ambracia became the capital of the kingdom of Pyrrhus, a clear change was observed in the dietary preferences of the population. We noticed a decrease in the consumption of terrestrial animal protein and an increase in the consumption of plant and marine protein. These observations reveal that the population is beginning to combine food sources to a greater extent, indicating the simultaneous exploitation of livestock, agricultural and fishery products. Our findings provide a basis for better understanding the colonial subsistence techniques in antiquity.



Investigation of spectral markers appropriate for optimized archaeogenetic analysis of ancient teeth and bones based on Raman scattering and fluorescence spectroscopy techniques

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Abstract

Ancient DNA (aDNA) and protein analysis of human remains (teeth, bones) is a very promising research field exploring a plethora of different topics related to human evolution and past societies [1]. Ancient DNA analysis generates exclusive data that cannot be retrieved otherwise, nonetheless, it normally requires -at least partial- destruction of valuable and unique archaeological samples. The destructive nature of aDNA analysis constitutes a major drawback when extracting DNA from valuable and rare samples, especially in cases where DNA preservation is poor [ENREF 19](#) resulting in low -if any- DNA yield. Moreover, for the discrimination of animal and human bone samples into collagen good or not good quality the common practice is the collagen extraction from bone fragments and the ¹³C, ¹⁵N isotope analysis. For these reasons, alternative methods to select samples, which are the most promising for archaeogenomics analysis are obviously of great importance. In this context, molecular spectroscopies can complement this topic in a time and cost-efficient manner [2].

In this study, Raman and fluorescence spectroscopy techniques were employed for investigating ancient dental samples and bones. We establish spectral indicators that can be correlated to the organic content (e.g. collagen) and further can be used to predict aDNA preservation levels in ancient human teeth and bones. This work will help to the determination of relevant spectral indicators and statistically supported thresholds, which can accurately discriminate between DNA-rich and DNA-poor dental samples and collagen-good and collagen-not good bone samples. Raman and fluorescence techniques will act as screening tools for archaeogenomics analysis. We expect that this pre-selection will ensure that ancient DNA analysis and isotope analysis are performed only on those samples, which are most likely to yield high amounts of collagen and further endogenous DNA.

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Developing a multi-analytical methodology for the detection and characterization of organic residues in archaeological findings using molecular spectroscopic techniques

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Abstract

The analysis of organic residues, found typically, yet not exclusively, as material remains adsorbed in the walls of archaeological ceramic containers, have been mainly analyzed using chromatographic techniques coupled with a range of detection methods (GC, GC-MS, HPLC, LC-MS) due to their high sensitivity and selectivity. However, they are destructive, require intricate and time-consuming sample preparation procedures with significant operational costs, and have a relatively low sample throughput, thereby limiting the number of samples that can be analyzed. The present research outlines (or discusses) the development of an efficient analytical protocol using Fluorescence, FTIR, micro-Raman, and NMR spectroscopies for the identification of key molecular species (biomarkers) in archaeological residue materials. Our objective is to implement a multi-analytical methodology, incorporating complementary spectroscopic techniques to detect and characterize organic residues preserved in archaeological samples. Analytical protocols and workflows were tested in the investigation of archaeological pottery samples containing residues from resin, beeswax, and plant/animal lipids, which were previously identified using GC-MS. Additionally, model samples were artificially aged to generate appropriate reference spectra and gain insights into degradation pathways and how these are reflected in the resulting spectra. The potential of molecular spectroscopic methods to guide subsequent analytical steps and offer faster, cost-effective alternatives for efficient screening and characterization of organic remains found as amorphous deposits or trapped within inorganic matrices is demonstrated.



Foodways and pottery production and use in the Indus Valley Civilisation: application of spectroscopic and spectrometric techniques

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Abstract

Gola Dhoro or Bagasra (Gujarat, India) is a small and rare fortified settlement (10 hectares) located in the Gujarat extension of the Indus Valley Civilization (3300 BCE to 1500 BCE). It is located 1 km from the Gulf of Kachchh and connects three different and culturally rich regions of Gujarat- Kutch, Saurashtra, and North Gujarat, making it a significant site in the broader region. Four phases were stratigraphically recorded as a precursor to a series of excavations, with sufficient evidence of interaction with other contemporary Chalcolithic Cultures. Subsequent studies have shown a rich cultural assemblage, and a difference in diet between people inside the fortification wall compared to those living in its periphery, principally on the basis of zooarchaeological studies amongst other things (Ajith 2014; Chase 2010; Sonawane 2004).

The present study focuses on the analysis of a pottery assemblage of 31 samples, varying in typology, time period and location from the site, aiming at elucidating subsistence and culinary practices and habits. The analytical techniques implemented encompass XRF for the initial grouping of the samples, FTIR for screening and information on technological aspects of pottery production, and finally, GC-MS to investigate the dietary practices of its inhabitants. The XRF suggested the presence of different clay chemical groups. FTIR using solvent extraction on 20 samples using ATR technique resulted in the detection of a variety of classes of organic components showing good preservation of organic residues, also providing possible evidence for dairy product consumption. GC - MS analysis of the samples to validate the results is currently underway.

The present study is anticipated to provide valuable insights into the Indus Valley Civilisation ceramic technology and dietary studies, ultimately allowing a better understanding of the nature of organic residues, as well as of the relationship between organic residues and vessel typology through time (different phases) and space.

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Doing biotech on a ...seasonal basis: the making of *psimythion* (5th- 3rd c BCE)

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Abstract

We recently revisited the production of *psimythion* (near-pure PbCO₃) following a recipe first mentioned by Theophrastus (*On Stones*, 57; 4th c BCE). In that paper (Photos-Jones et al. 2020), we highlight the importance of the biotic component, *oxos*, during its preparation, in which a piece of Pb metal is suspended over the liquid *oxos* in a closed jar. *Oxos* is often translated as ‘vinegar’, but the Liddell -Scott-Jones dictionary offers three separate meanings: *poor wine*, ‘*vin ordinaire*’, and ‘*vinegar*’, made therefrom’ (<https://stephanus.tlg.uci.edu/lsg/#context=lsj&eid=76595>).

We consider the oenological meaning of each and suggest that *oxos* was never about vinegar *per se*, because *psimythion*-making required an active carbon-dioxide production by yeasts during alcoholic fermentation (i.e., the conversion of sugars into alcohol). It follows that *oxos* would have had to be ‘extracted’ before acetic acid fermentation was completed; it becomes less clear what ‘*oxos* made from vinegar’ actually means.

We suggest that given that in antiquity there was no way, known to us, for physically stopping the conversion of grape juice to vinegar, *psimythion*-making would have had to be well-embedded within the seasonal cycle of grape harvest, wine making and vinegar production and as a distinct intermediate product in its own right.

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The contribution of residue analysis in the interpretation of prehistoric quartz chipped stone tools

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Abstract

Our research evaluates residue analysis's contribution to understanding the role of quartz-chipped stone tools in prehistoric societies. It is focused on a large-scale study of residues found adherent on quartz chipped stone artifacts from four archaeological sites: “Angitis Springs” site (late Middle Palaeolithic), Kolominitsa cave (Upper Palaeolithic), Thessaloniki International Fair (Middle Neolithic settlement) and Thessaloniki Toumba (Middle-Late Bronze Age settlement). The current lithic assemblages constitute case studies of the Ph.D. research “Quartz in prehistoric societies of Greece from the Palaeolithic to the Mycenaean Age: uses and interpretations”. Low-power optical microscopy was performed on the total sample of the quartz artifacts using stereo microscopes with a magnification range of 10-50x and a USB digital microscope (magnification within the 10x-300x range). The residues were documented according to their characteristics (colour, structure, position, distribution and possible co-occurrence of use-wear on tools). Optical microscopy morphological identification was based on referential archaeological and experimental published data. The analytical protocol was further developed with non-destructive energy dispersive X-ray fluorescence (EDXRF) to selected implements. Tiny specimens of selected residues were extracted and further examined under a scanning electron microscope equipped with an energy-dispersive X-ray spectroscope (SEM-EDS) and with micro-Fourier Transform Infrared spectroscopy (micro-FTIR) using a 6Ax64 FPA detector. This multidisciplinary approach allowed the recognition of various environmental and functional residues with a high degree of certainty. The results revealed residues of organic and inorganic origin including plant, animal and mineral materials. Our research contributes to the diachronic understanding of prehistoric quartz tools’ function, use as well as to site activities.



Modern techniques on extremely old fossils: the case of conodonts

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Abstract

Conodonts are one of the most enigmatic types of fossils, as their attribution to a specific taxonomic group remained elusive for decades. They are small phosphatic tooth-like elements belonging to the feeding apparatus of an extinct group of elongated soft bodied marine chordates (Sweet et al., 2001) that lived 541 to 201 My ago (Cambrian to Triassic age). Apart from their immense biostratigraphical significance (Metcalf et al., 2003), lately conodonts have begun being analyzed with numerous techniques (Electron Microscopy, analytical techniques, isotopic methods, dating methods, Vibrational Spectroscopy, etc., to better understand their biomineralization, their ontogenetic and phylogenetic development, palaeoenvironmental factors and their diagenesis. In addition, when conodonts are heated or subject to metamorphism in the subsurface, they progressively and irreversibly change colour. This gives us useful information about intergenerational temperatures and burial depth on a fixed scale called Conodontal Colour Alteration Indices (CAI). This has been used extensively in the petroleum industry as an index of thermal maturation, of mineralization temperature (Rejebian et al., 1987) and in regional basin history and tectonic studies (Metcalf, 2003).

Conodonts have also been reported from several formations/outcrops throughout the Hellenic peninsula. Our goal was to apply such modern techniques on material from 11 locations for the first time and begin to study and grade the conodont assemblages, as a first attempt to describe their characteristic features and create a distribution map, which will be enriched in time with new material from other locations and be correlated to specific procedures. In total, more than 1000 conodont elements were studied via a stereoscope, a Scanning Electron Microscope and X-Ray microanalysis.

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Bioerosional tunneling in the dentine of the pygmy Hippo of Cyprus.

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Abstract

During this study, observations were made concerning dentine preservation and bioerosional tunneling. The dental material used for this study consists of ten molar teeth of the pygmy Hippopotamus species *Phanourios minor* from the fossiliferous site of Aghia Napa in Cyprus, an endemic species that lived exclusively on Cyprus during the Late Pleistocene (11-13,500 years B.P.) (Fillipidi *et al.*, 2013).

In order to study the dental microstructure via a Polarizing Optical Microscope and a Jeol JSM 6390 Scanning Electron Microscope, thin sections and polished embedded samples were prepared.

Intriguing features, such as fossilized odontoblastic processes were observed and described. The odontoblastic processes are extensions of cells called odontoblasts, which forms dentin in a tooth and are located within the dentinal tubules, which are easy to be seen in the dentine area. The odontoblast processes were found either intact or cropped, in groups or isolated, and mainly inside the dentinal tubules. At the same time, bioerosional phenomena were observed throughout the dentinal tissue, such as bacteria colonies and filaments. The bacteria colonies are exhibited as pores and tunnels within characteristic rims, resulting from the dissolution of dentine caused by bacteria feeding on collagen. Filaments are fossilized bacteria, forming 3D structures. The bacteria colonies are attributed to exogenous microbes indicating relatively humid aerobic terrestrial environments with high temperature and a pH: 4–9 (Hedges *et al.*, 1995). The filaments detected, could possibly be attributed to the endogenous symbiotic bacteria Actinomycetales (Kalthoff *et al.*, 2011).

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Κτερίσματα και προσφορές από οργανικά υλικά στο νεκροταφείο του Δέλτα Φαλήρου

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Περίληψη

Στο ανατολικό παράκτιο τμήμα του παλαιού κόλπου του Φαλήρου, σε μία αμμώδη περιοχή μεγαλύτερη των 11 στρεμμάτων ήλθε στο φως πρόσφατα το νεκροταφείο του Δέλτα Φαλήρου. Ήταν γνωστό ήδη από τις αρχές του 20^{ου} αιώνα, αφού ένα πολύ μικρό μέρος του είχε αποκαλυφθεί από τους Σ. Πελεκίδη και Γ. Κουρουνιώτη. Έως σήμερα έχουν αποκαλυφθεί, συνολικά, 2132 ταφές διαφόρων τύπων, όπως απλοί ενταφιασμοί, πρωτογενείς καύσεις, ενταφιασμοί μέσα σε λάρνακες και αγγεία. Η χρήση του ήταν μακράιωνη αφού καλύπτει μία περίοδο από τα τέλη του 8^{ου} αιώνα έως και τα τέλη του 4^{ου} αιώνα π.Χ. Το σύνολο των ταφών βρέθηκε εντός του παράκτιου αμμώδους στρώματος που αποδείχτηκε ως «αφυλόξενο» για τη διατήρηση μίας σειράς αντικειμένων από οργανικά υλικά που χρησιμοποιήθηκαν από τους ζώντες συγγενείς των νεκρών είτε ως προσφορές στον τόπο ταφής είτε ως συνοδευτικά στο ταξίδι τους στον Κάτω Κόσμο. Εντούτοις κάποια εξ αυτών διασώθηκαν και αποτέλεσαν μία επιπλέον πηγή των ταφικών πρακτικών, η μελέτη της οποίας καθιστά πιο εύληπτη σε εμάς την οπτική της ιδέας του θανάτου από την αρχαία αττική κοινωνία.

Στην παρούσα ανακοίνωση θα παρουσιαστούν κατάλοιπα διασωθέντων αντικειμένων από οργανικά υλικά και θα διερευνηθεί η ταφική χρήση τους. Μέσω της οπτικής μικροσκοπίας και των τεχνικών SEM/EDS και FT-IR έγινε προσπάθεια αναγνώρισης των οργανικών υλικών από ταφές βρεφών και μικρών παιδιών, η θνησιμότητα των οποίων ήταν αρκετά υψηλή, ιδιαίτερα κατά την Πρώιμη Αρχαϊκή περίοδο. Οι αναλύσεις έγιναν σε δείγματα υλικών που ελήφθησαν μετά την σχετική αδειοδότηση.

Από την προκαταρκτική εξέταση των δειγμάτων αναγνωρίστηκαν υπολείμματα ουσιών, πιθανών οργανικών ελαίων, χρωστικών και υφασμάτων, ορυκτοποιημένων και σε θραυσματική κατάσταση, ενώ ανιχνεύτηκε και η σύστασή τους. Η διατήρηση οργανικών υλικών είναι εξαιρετικά σπάνια στην Ελλάδα λόγω των επιθετικών ταφονομικών διεργασιών και των περιβαλλοντικών συνθηκών που επικρατούν και προσφέρουν σημαντικές πληροφορίες για τη μελέτη των εθίμων στην Αττική εκείνη την εποχή.



Θεματική Συνεδρία: Θετικές Επιστήμες στη Συντήρηση

Επίκαιρα ζητήματα της σύγχρονης θεωρίας της συντήρησης

Μαρία Μερτζάνη

Προϊσταμένη της Διεύθυνσης Συντήρησης Αρχαίων & Νεωτέρων Μνημείων

Περίληψη

Πόσο συχνά είναι σήμερα οι αρχές της αντιστρεψιμότητας και της ελάχιστης επέμβασης κυρίαρχες στις επεμβάσεις μας; Πόσο συνεργατική και ουσιαστική είναι η διεπιστημονική προσέγγιση για τις προτάσεις επεμβάσεων; Πόσο ερμηνευτική είναι η διερεύνηση των υλικών όσο και παρακολούθηση των περιβαλλοντικών συνθηκών; Είναι δυνατή η λειτουργική αποκατάσταση ενός μνημείου και με ποιες προϋποθέσεις; Σε έναν κόσμο που αλλάζει κι εξελίσσεται μέσα από προκλήσεις, ενδεχομένως η ορθολογική αιτιολόγηση των επεμβάσεων αποτελούν τη σύγχρονη φιλοσοφία της συντήρησης.



Non Destructive Testing (NDT) methods for the evaluation of new green materials for artwork conservation

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Abstract

The present work refers to the preliminary results of the on going research within the European programme HORIZON-CL2-2021-HERITAGE-01 **GREENART**: GREEn ENdeavor in Art ResToration. The GREENART research program highlights the protection and conservation of the cultural heritage through a multidisciplinary approach gathering hard and soft sciences and engineering. GREENART proposes new solutions based on green and sustainable materials and methods to preserve, conserve and restore cultural heritage. Coordinated by the Consorzio Interuniversitario per lo Sviluppo dei Sistemi a Grande Interfase (CSGI) based in Florence, GREENART brings together an impressive number of leading European research institutes and universities, as well as professionals in the sector and major international museums such as the Solomon Guggenheim Foundation, LACMA, the Tate Gallery and the prestigious Metropolitan Museum of Art (MET). The first part of the research involves curative conservation. This entails replacing existing polymers, solvents and surfactants with biological, natural or low-impact materials that are fully sustainable. The second part of the research focuses on systems to replace traditional consolidants, coatings and packaging materials with plant proteins and polysaccharides from renewable resources. For example, protective coatings from cellulose waste or even shellfish, or biodegradable packaging foam, all of which are, of course, noninvasive and reversible. The third part is focused on the application of Non Destructive Testing in order to evaluate all new green materials, on mock ups as well as on real artefacts. Towards this aim, ARTICON Lab *Conservation Promotion of Visual Art, Book and Archival Material* of the University of West Attica is developing new methodologies, mainly based on spectral imaging techniques, to test optical and mechanical properties of the surfaces before and after application of the new materials. Their functionality in the cleaning, the covering and the consolidation process within the frame of a conservation treatment is also under evaluation.



Integrated Research for the Characterisation of the Construction Technique of Mural Paintings from Two Different Sites of the Vatopedi Monastery (Mount Athos, Greece)

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Abstract

The Monastery of Vatopedi (or Vatopedi) was built in the 4th century and it is the second in the hierarchy of the Mount Athos' Foundations. It is located in the middle of the north-eastern side of the peninsula. Vatopedi is a big monumental compound, enclosed by a tall wall, and its buildings are organized in triangular shape. In the big yard lays the central church or *Katholikon*, which is dedicated to the Annunciation of the Virgin, the dining hall made in the shape of the cross and thirty-three chapels.

The specific research is focused on the characterisation and documentation of the materials, construction techniques and preservation state of the wall paintings from two different sites of the Vatopedi Monastery. The first site is the *Katholikon* (Fig. 1), which was built in the 10th century and the second site is the Chapel of St Anargyroi (Fig. 2), one of the oldest Middle Byzantine temples of Mount Athos, built in the 14th century.

Both sites, after their completion, were painted, repainted and restored several times by different artists and workshops, and in different chronological phases, throughout the millennial operation of the monument. Given the importance of the monument, the aim of the research is to document the construction technique, the different phases, to identify selected pigments and materials and to contribute towards the correct conservation and restoration policy.

For the completion of the research objectives, a combination of molecular, elemental and optical techniques were employed. Imaging techniques were employed for the recording of invisible elements. Micro-Raman spectroscopy, (portable) Fourier-transform infrared spectroscopy and X-ray fluorescence, were chosen for physicochemically characterizing the pigments, grounds and components used (primary and conservation materials) and conclude on the construction technique (layer by layer identification) applied on the mural paintings of both sites. Especially for the micro-Raman spectroscopy the point analysis identified the original materials, sometimes present in complex mixtures, together with other compounds. Next to the point analysis, Raman mappings helped the overall research by revealing the spatial distribution of materials found on cross

sections. Optical and fluorescence microscopy recorded the stratigraphy of the complex cross sections, by differentiating restoration layers or post-treatments from the initial ones and by visualizing the construction sequence and hence the construction technique. Finally, Digital Holographic Speckle Pattern Interferometry was employed in order to document the preservation state of the mural paintings.

Taking into consideration the importance of the monument, scientists from different institutions and backgrounds worked together in order to bring to light the history of these highly important wall paintings.



Figure 1. The main Church (*Katholiko*) of Vatopedi monastery, Mount Athos.



Figure 2. The chapel of St Anargyroi of Vatopedi monastery.

Keywords: Raman spectroscopy, material characterization, wall painting analysis, Mount Athos, Vatopedi monastery, imaging techniques, optical microscopy, X-Ray Fluorescence, Infrared spectroscopy, interferometry

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Διαγνωστικές τεχνικές σε πήλινα πολύχρωμα ειδώλια κλασικής και ελληνιστικής περιόδου από την Χαλκίδα

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Περίληψη

Το αντικείμενο της ανακοίνωσης πραγματεύεται την εφαρμογή διαγνωστικών τεχνικών σε τρία πήλινα πολύχρωμα ειδώλια κλασικής και ελληνιστικής περιόδου από την Χαλκίδα με ανασκαφικές επικαθίσεις, προσφέροντας στον συντηρητή αρχαιοτήτων ασφαλέστερους τρόπους ως προς τη διαχείρισή τους. Οπτική μικροσκοπία, πολυφασματική απεικόνιση UVF και VIL, αναλυτικές τεχνικές XRF και FTIR γνωστοποιούν υλικά της τεχνολογίας κατασκευής τους καθώς και υλικά από παλαιότερες επεμβάσεις συντήρησης. Με την εφαρμογή αυτών των τεχνικών παρέχονται σημαντικές πληροφορίες για την ερμηνεία της λευκής επικάλυψης καθώς και της γραπτής, πλαστικής και επίθετης διακόσμησής τους. Η ύπαρξη υπολειμμάτων αιγυπτιακού κυανού εντοπίζονται ακόμη και κάτω από τις ανασκαφικές επικαθίσεις γεγονός που δεν μπορεί να διακρίνει το γυμνό μάτι, ενώ η εφαρμογή οργανικού υλικού όπως το ριζάρι φθορίζει διαφορετικά σε αντίθεση με πρόσθετα υλικά αποκατάστασης. Η επικασσιτέρωση με φύλο κασσιτέρου είναι δεδομένη στα δύο αντικείμενα, ενώ στο τρίτο η διατήρηση οργανικού συνδετικού μέσου στη γραπτή, αλλά και η χρήση αναρτώμενων μεταλλικών στοιχείων στην επίθετη διακόσμηση, δίνουν σαφείς ενδείξεις μιας ομολογούμενης ιδιαίτερης κατασκευής.

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ΑΝΑΡΤΗΜΕΝΕΣ ΑΝΑΚΟΙΝΩΣΕΙΣ

Θεματική Συνεδρία: Λίθοι-Χρωστικές-Κονιάματα

Archaeometric Investigation of Painting Decoration in Derveni's Grave I, Thessaloniki

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Abstract

The tomb was discovered at the site of Derveni in Thessaloniki during the excavation of the road leading to the Macedonian tomb III. The burial monument dates from the time of Cassander to the early 3rd century B.C. The rich painting decoration of the tomb is of great interest.

The study provides a historical review of the archaeometric research of the tomb I that began in 1995.

Herein the previously collected results are revisited and moreover, for the first time, new results related to the decorative features of the tomb are presented. Initially the following techniques were used: polarizing microscopy, optical emission spectroscopy (OEA) and X-ray diffractometry (XRD). In the second step of the study, the following methods were also employed: Scanning Electron Microscopy (SEM) in conjunction with Energy Dispersive Spectroscopy (EDS), X-Ray Fluorescence (XRF) and FTIR spectroscopy.

The distinctive architecture of the tomb is associated with the two different bases of the mural. The upper sections of the wall painting are spread on the stone masonry, while the lower section on the solid clay ground base. The stone of the masonry is calcareous sandstone consists of three main components: quartz, feldspars and calcite. The clay base in the lower zone consists of clay minerals: montmorillonite, kaolinite and illite. This architectural particularity of the mural had as a consequence the differentiation in the composition of the corresponding mortars.

In addition, seven main pigments of the mural were identified:

- Cyan – it is Egyptian blue, in the composition of which cuprorivaite crystals were found along with glassy material, possibly lead glass.
- Yellow pigment – it is yellow ochre of the mineral goethite.
- Dark red – it is red ochre of the mineral hematite.
- Bright red – it is cinnabar

- Bright green – it is malachite.
- Plant black.
- White from calcite mineral.

The painting technique which was applied in the tomb is "fresco a'secco" using lime as binder. In the surface painting layers, to model the volume and shade, pigments with an organic binder were used. The FTIR analysis of these layers give indications of the presence of gum arabic. The study also compares the results of the archeometric examination carried out on other ancient monuments of the area.

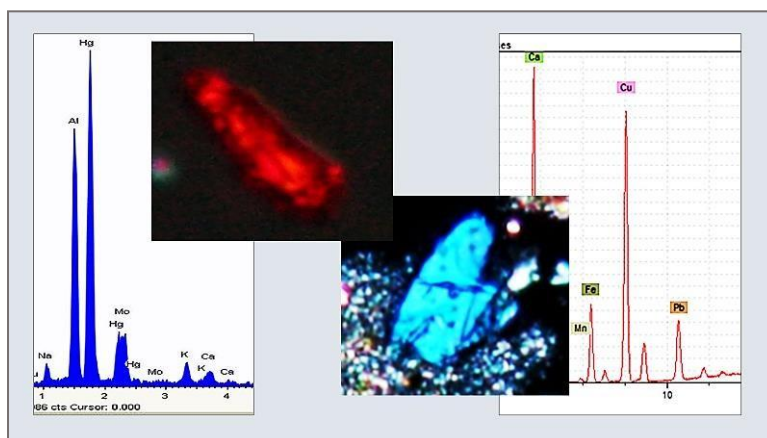


Fig.1. Cinnabar and Egyptian blue. Polarizing microscope. SEM-EDS and XRF spectra.

Keywords: wall paintings, 3rd century B.C., OEA, XRF, SEM- EDS, FTIR, Raman, XRD, Derveni, Thessaloniki.

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Το έργο του ζωγράφου Αγοραστού στη Θεσσαλία του 17ου αιώνα , συντήρηση εικόνων και ανάλυση χρωστικών

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Περίληψη

Ο ζωγράφος Αντώνιος Αγοραστός έγινε γνωστός μετά από την καταγραφή ενεπίγραφων εικόνων του στη Σκόπελο από τον Παύλο Λαζαρίδη, που καλύπτουν διάστημα 30 χρόνων 1667-1703. Οι ενυπόγραφες εικόνες που μελετήσαμε στον Τύρναβο, είναι οι δυο εικόνες της Παναγίας και του Χριστού στο τέμπλο του ναού των Αγίων Αναργύρων εκατέρωθεν της Ωραίας Πύλης. Στόχος της έρευνας η μελέτη των χρωστικών του αγιογράφου και η αξιολόγηση άλλων μη-ενυπόγραφων εικόνων. Σε χρυσό βάθος εικονίζεται ένθρονη η Παναγία στον τύπο της Βρεφοκρατούσας. Αποδίδεται καθήμενη μετωπικά να κρατάει μπροστά της τον Χριστό. Κάτω δεξιά διακρίνεται επιγραφή με το όνομα του ζωγράφου, χειρ Αντωνίου υποδιακόνου Αγοραστού του Κριτός (1668). Επίσης σε χρυσό βάθος εικονίζεται ένθρονος ο Ιησούς Χριστός στον τύπο του Παντοκράτορα. Με το δεξί του χέρι ευλογεί και με το αριστερό κρατά ανοιχτό ευαγγέλιο.

Για τις μετρήσεις των χρωστικών στις εικόνες χρησιμοποιήθηκαν : α) Raman φασματοσκοπία Thunder Optics - Gem Raman System με διέγερση λέιζερ 532nm, ενώ πριν από τη ταυτοποίηση, τα φάσματα υποβλήθηκαν σε διαδικασία όπως το baseline correction, Savitzky - Golay smoothing - normalization [1] και β) την τεχνική XRF φασματομέτρο Niton XLp 818 με πηγή διέγερσης 241 Am. Η ανάλυση των φασμάτων Raman και XRF πραγματοποιήθηκε με τη βοήθεια του λογισμικού Spectragryph [2]. Η ταυτοποίηση των χρωστικών με τη χρήση των δύο συμπληρωματικών τεχνικών ανέδειξε τη χρήση μιας ποικιλίας ανόργανων χρωστικών όπως το λευκό μολύβδου, το πράσινο του χαλκού (verdigris), το μπλε του χαλκού (αζουρίτης), για το κίτρινο (realgar), οι σιδερένιες ώχρες (κόκκινο και κίτρινο), η κιννάβαρη για το κόκκινο χρώμα.

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Αρχοντικό Γεωργίου Σβαρτς: αρχαιολογική προσέγγιση

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Περίληψη

Εξαιρετικό δείγμα κοσμικής αρχιτεκτονικής και ζωγραφικής διακόσμησης του όψιμου 18ου αιώνα στον Ελληνικό χώρο, αποτελεί το αρχοντικό Γεωργίου Σβαρτς στα Θεσσαλικά Αμπελάκια, τα οποία φημίζονται για τον συνεταιρισμό {...Συντροφιάς των Αμπελακίων (1777-1812,...)} (ΔΙΑΜΑΝΤΟΠΟΥΛΟΥ, 2003, p. 11). Οι κάτοικοι των Αμπελακίων ασχολούνταν με τη βαφή και το εμπόριο βαμβακερών νημάτων, η οποία γινόταν με τη χρήση του φυτού ριζάρι. Πλούσια ζωγραφική διακόσμηση του αρχοντικού, με τοπιογραφίες, άνθινες παραστάσεις με έντονα χρώματα, περίτεχνοι φεγγίτες, ολόγραφα ταβάνια, πολύχρωμες ξύλινες επενδύσεις στους τοίχους, καταστόλιστα τζάκια, χαρακτηρίζουν τον πλούτο και την μεγαλοπρέπεια των Αμπελακίων. Αντιπροσωπευτικό δείγμα ζωγραφικής διακόσμησης συναντούμε στο βορεινό σοφά στο ανώι, όπου φέρει γραπτή απομίμηση κεραμικών πλακιδίων στις φρίζες (...απομιμήσεις κεραμικών στους τοίχους,...), (ΓΑΡΙΔΗΣ, 1996, p. 80), η οποία εναλλάσσεται στον βόρειο τοίχο με πολύχρωμους φεγγίτες. Άνθινες συνθέσεις στολίζουν παράλληλα τα κοιλόκυρτα επίκρανα του τριβήλλου. Η ξύλινη ανατολίζουσα μπακλαβαδωτή οροφή του φέρει στο κέντρο (...ανεστραμμένο ολόγλυφο ρόδι...) (ΧΟΥΛΙΑ, 2010, p. 22).

Για τις μετρήσεις των χρωστικών στις εικόνες χρησιμοποιήθηκαν : α) Raman φασματοσκοπία Thunder Optics - Gem Raman System με διέγερση λέιζερ 532nm, και β) την τεχνική XRF φασματομέτρο Niton XLp 818. Η ταυτοποίηση των χρωστικών ανέδειξε τη χρήση μιας ποικιλίας ανόργανων χρωστικών όπως το λευκό μολύβδου, το κόκκινο του μολύβδου, το πράσινο του χαλκού (verdigris), το μπλε του χαλκού (αζουρίτης), οι σιδερένιες ώχρες (κόκκινο και κίτρινο), αλλά και οργανικές χρωστικές όπως το ριζάρι (κόκκινο χρώμα).

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Pigments on votives from Bronze Age Kapros on Kephallenia, the Ionian Sea: preliminary results from non-destructive spectroscopy techniques

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Abstract

Kapros occupies the easternmost promontory of the largest island of the Ionian Sea. Discovered by the Archaeological Shoreline Research project (A.Sho.Re.) in 2013, it includes a small, maritime cavern, containing hearths, a stone bench and a stone-built spout at floor level, also highly fragmented sherds of largely miniscule cups and jugs, as excavated in 2019. Deposit structure and context, being quite unprecedented on Kephallenia, calls for further analysis, in order to shed light on the surviving pottery and the assemblage at large.

The aim of the paper is to present the first results from the study and the analysis of the pigments, which were used for the decoration of the clay votives from the excavations of Kapros. The analyses of the coloured surfaces of clay votives with non-destructive spectroscopic methods p-XRF and p-RAMAN were carried out in the conservation laboratories of the Ephorate of Underwater Antiquities at Athens.

Identification of pigments using the two complementary techniques revealed the use of a variety of inorganic pigments including red and yellow ochres, calcium white, etc. These analyses will hopefully shed light on aspects of clay votives that are not customarily subjected to the analytical methodology here employed, especially in the archaeology of the Ionian Sea.

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Materials analyses of stone votives from the Peak Sanctuary at Vrysinas (Rethymnon, Crete) applying spectroscopy techniques

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Abstract

The aim of the paper is to present the first results of the mineralogical and geochemical study of stone votives (artifacts and vessels) excavated in the biggest Peak Sanctuary in west Crete (Rethymnon), at the Minoan site of Vrysinas (ca. 2000-1550 B.C.E.). For the study and analysis of stone votives we applied spectroscopy techniques, such as XRF, RAMAN and XRD to confirm a range of various lithologies in the stone vessels and artifacts from Peak Sanctuary at Vrysinas. The analyzes were carried out in the laboratory of the archaeological museum of Rethymnon and at the Technical University of Crete. Most of the stone artifacts and vessels ascertain that were made of serpentinite, but also other rocks such as limestone, marble, gabbro, quartz, etc were identified. The most of these rock-types are related to various geological formations occurring in Crete such as ophiolite nappes. The results of this paper add another lost link to the ancient technology of Minoan civilization and surprise us with the use of a variety of raw materials, both domestic and imported for the construction of stone votives.

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Technical investigation of an outstanding Cretan icon

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Abstract

In the current work authors investigate the painting materials and techniques of a particularly important Cretan icon of the “Virgin Mary of the Passion”. The icon is of extremely high painting quality and, on the basis of its stylistic features, it can be dated to the early post-Byzantine period (~mid-15th to mid-16th c. AD). However, on the lower left margin of the work there is a faint signature with the name of Emmanuel Tzanes and a much later date (166(;)), both of which seem irrelevant. In order to better understand and assess the painting in consideration, the artifact was subjected to a thorough analytical investigation by means of digital microscopy, UV-induced visible fluorescence and Infrared photography, X-ray radiography and X-ray fluorescence spectroscopy (XRF). Furthermore, selected microsamples were examined through optical microscopy (OM) and electron microscopy coupled with energy dispersive X-ray analyzer (SEM-EDX), as well as through micro-Raman spectroscopy. The analytical data were evaluated under the light of previous pertinent studies (Karapanagiotis *et al.*, 2013; Mastrotheodoros *et al.*, 2020) leading to the identification of a rich palette that includes a Cu-based blue pigment and a notably luminous green earth. Also, it is documented that the gildings of the work have been rendered using high purity gold-leaves, while numerous earlier conservation interventions were spotted as well. Additionally, it appears that the aforementioned signature is not original, and is currently interpreted as a later addition, presumably introduced to increase the value of the item or to stimulate the interest of potential patrons. In this framework it is graphically demonstrated how the archaeometric data can considerably contribute the archaeological and art-historian research of painted artifacts.

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Elemental analysis of prehistoric chert artifacts from Kastritsa cave (Epirus, NW Greece) with the use of non-destructive XRF method

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Abstract

Chert artifacts from the Upper Paleolithic site of Kastritsa, were analyzed in order to trace similarities between macroscopically similar types of raw material. The cave lies on the western side of the Kastritsa hill, in the eastern part of lake Pamvotis at Ioannina, North-Western Greece. Twelve of the revealed cherts were brought to the Laboratory of Composed and Ceramic Materials of the Department of Materials Science and Engineering of the University of Ioannina to perform single point elemental analysis and create two dimensional elemental maps. The aim of this analysis was to investigate probable connections between macroscopic characteristics of the cherts (color, morphology) and the concentration of various abundant and trace elements. Elemental mapping of the stone artifacts revealed interesting features with the presence of some elements throughout the outmost layers of them like Si, K and in less extent Ti. In contrast, Ca and some other elements like Fe and P were pronounced in spots, clearly colored altered, compared with the rest of the mapped areas. Regarding elemental concentrations, high values were observed for Si (43-66%) while much lower values and high variation from sample to sample for Ca (0.1-5.5%), Al (0.4-2.6%) and P (<LOD-1.6%). Concentrations less than 1% were assessed for the rest of the observed elements like K, Fe, Mg, S, Ti, Mn, Ni, V.



Θεματική Συνεδρία: Νέες και εδραιωμένες εφαρμογές στην Αρχαιολογία

Ψηφιακό μουσείο, η χρησιμότητά του, τα απαραίτητα τεχνικά χαρακτηριστικά για την εφαρμογή του στον πολιτισμό

Ποια προγράμματα αναδεικνύουν τα ψηφιακά μουσεία, ποια η γνώμη των αρχαιολόγων για αυτά

Βασιλική-Γεωργία Αργυρού

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Περίληψη

Γνωρίζουν οι αρχαιολόγοι τα απαραίτητα ηλεκτρονικά προγράμματα για την διαχείριση ενός ψηφιακού μουσείου; Ποια μπορούν να χρησιμοποιηθούν για την ψηφιοποίηση αντικειμένων που ανήκουν στον πολιτισμό; Για ποιους λόγους είναι απαραίτητη η ψηφιοποίηση των αντικειμένων; Αυτά τα ερωτήματα θα αναλυθούν στην παρούσα έρευνα προκειμένου να ενημερωθεί το κοινό για τα εργαλεία ψηφιοποίησης. Στην παρούσα έρευνα θα δούμε και τα απαραίτητα εργαλεία με τα οποία θα μπορούν να στήσουν μια ψηφιακή έκθεση ή και ένα ολόκληρο μουσείο, τα απαραίτητα προγράμματα, με σκοπό την ενημέρωση για την αναγκαία κατάρτιση του σύγχρονου αρχαιολόγου.

Θα παρουσιαστούν αποτελέσματα από ερωτηματολόγιο, στο οποίο θα συμμετέχουν μόνο άτομα από τον πολιτισμό και ιδιαίτερα αρχαιολόγοι. Σκοπός του ερωτηματολογίου είναι να καταδείξει την αναγκαιότητα της εκπαίδευσης πάνω στον ψηφιακό πολιτισμό και τις απαιτήσεις από τους φορείς για την ψηφιοποίηση των αντικειμένων. Η μεθοδολογία της έρευνας του ερωτηματολογίου θα είναι μικτή, ένα μέρος ποιοτικής έρευνας με συνεντευξιαζόμενους και ένα γενικό σύνολο ποσοτικής έρευνας, στο οποίο θα μελετάται κατά πόσο γνωρίζουν οι συμμετέχοντες από βασικά εργαλεία ψηφιοποίησης. Θα αναλυθεί η χρησιμότητα των προγραμμάτων : Youtube, scratch, Artsteps, Spartial, ψηφιακά περιβάλλοντα σχεδιασμένα στο unity, sketch up, χάρτες με ArcGIS και Google Earth, βίντεο ξενάγησης και κατασκευή τρισδιάστατων απεικονίσεων. Θα αναλυθεί επίσης, η συμβολή του ψηφιακού μουσείου στο Μάρκετινγκ και πώς θα μπορούσαν να βελτιώσουν την προσέλευση στους αρχαιολογικούς χώρους. Μέσα από την ανάλυση των προγραμμάτων θα δούμε και τον αντίκτυπό τους πάνω στην παιδεία. Με την ανάλυση των αποτελεσμάτων της έρευνας θα μιλήσουμε για την αναγκαιότητα να γνωρίζουν οι αρχαιολόγοι τρόπους διαχείρισης ιστοσελίδων, ώστε να μπορούν να ενημερώνουν μόνοι τους τις ιστοσελίδες των μουσείων που εργάζονται. Με αυτό το αποτέλεσμα της έρευνας θα αναδείξουμε την αναγκαιότητα της κατάρτισης των εργαζομένων του πολιτισμού για την καλύτερη οικονομική διαχείριση μιας χορηγίας από φορείς του δημοσίου.



Keywords: πολιτισμός, ψηφιακά προγράμματα, ψηφιοποίηση, ψηφιακό μουσείο, μουσειακά αντικείμενα, σχεδιασμός

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Age assessment of monumental olive trees from the Ionian islands, Western Greece, using three different individual dating approaches

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Abstract

Olive tree cultivation dates back to more than 6000 years, to the beginning of the Neolithic period when farming was invented, first around Mesopotamia and later spreading westwards and northwards throughout the Mediterranean and along the Anatolian and Greek coasts. Age assessment of olive trees becomes extremely important for understanding Mediterranean civilizations. The fact that the core region of an olive tree starts decomposing as it gets older presents a serious drawback for direct ¹⁴C dating and dendrochronological analyses of olive trees. Generally, olive tree dating is performed using a gross estimation of the dimensions of the corresponding trunks. A plethora of olive trees with trunk perimeters larger than 10 m can be found in Ionian Region, Crete, Anatolian coast, Israel and mainland Greece.

The present study focuses on several monumental olive trees that were recorded and mapped by the Ionian University, located at the Ionian islands (Corfu, Paxoi, Cephalonia, Ithaca, Lefkada and Zakynthos), in the Western part of Greece. Their corresponding perimeters at human breast height, ranges between 7.5 m and 15 m. Towards an effort to preserve these monumental olive trees, dating was attempted using the following three approaches: (a) calculation of the radial growth rate from the existing, healthy wood pieces and calculating the number of rings (thus the age) that correspond to the radius of each tree according to the respective perimeter; (b) radiocarbon dating for selected pieces of wood from the trunks and (c) OSL and IRSL dating of the palaeo-sediments either surrounding or beneath the roots of the olive trees. The radial growth rate for these specific monumental trees was calculated within the range 0.8 – 1.2 mm per year, resulting thus in ages according to the geometric features well above 1000 yr. All ages will be discussed in the frame-work of the existing models.



Stimulated luminescence and obsidian hydration ages of archaeological interest from Greece and Turkey; an obvious hiatus within the 4th millennium BC

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Abstract

The Eastern Mediterranean Basin, consisting of mainland Greece, Anatolia along with the Aegean Sea and all related islands, is being considered among the most important cradles of civilizations all around the world. Major civilizations have emerged, flourished and decayed within this specific region. The area is also noted for epic sagas. The region has produced rich and significant archaeological data, among which archaeological ages as well, that have enriched our knowledge of the area's historical development. The archaeological study of the area has resulted in thousands radiocarbon dates throughout the entire history span. On the contrary, an extended bibliographical survey indicated that all stimulated luminescence ages that were reported in the literature are not exceed the 500. All these were collected in a database, along with the ages obtained based on obsidian hydration dating. The aim of the present work is to present them together and discuss specific features regarding their spatial distribution and historical span. The majority of these ages concern TL ages of either pottery fragments or kilns. Nevertheless, a substantial amount of surface luminescence dates based on optical stimulation has been reported from the area. Some of these luminescence ages are either directly or indirectly linked to specific historical as well as mythological events. According to these ages, specific centuries within the Aegean chronology witness a decrease in the number of dates, indicating a peculiar hiatus. The most prominent is the 4th millennium BC gap, a well-established hiatus based on the lack of radiocarbon ages, for which there has been a lot of archaeological discussion. Finally, for major pillars of archaeological dating, such as silica colored mosaic tesserae, slags, mortar and rizzolith, the pioneer applications were reported within this specific region.



How the digitisation of a post-Inka Khipu artefact from Peru enabled a multivariate analysis for sign reduction

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Abstract

The Khipu (K'ipu or Quipu) of Peru, an ancient writing system of plied coloured cords and knots, was traditionally used for accounting and narrative record-keeping (Ascher and Ascher, 1981; Conklin, 1982). After the fall of the Inka empire, the Khipu continued to adapt to colonial and ceremonial tribute practices with the appearance of hybrid wooden Boards: a combination of alphabetic and Indigenous Khipu script (Hyland, Ware and Clark, 2014; Llanos, 1986; Tello and Miranda, 1923). Among the most notable advances in Khipu studies was the morphological understanding that variable (sign) redundancy is present (Conklin, 1982). However, no previous study incorporated archaeometry to show how key signs on a hybrid Khipu might have functioned in clusters and to offer an interpretation of these. After creating a digital quantitative record of the Mangas Khipu Board (c. 1800–1900 AD), I used multivariate analysis (CATPCA) to systematically understand the Indigenous script. Based on observations by native archaeologist and anthropologist Julio C. Tello (and Miranda, 1923) of a community Khipu Board in the 1920s and recent ethnographic data, I detected and interpreted four dimensions of work tribute recorded on the Mangas Khipu Board which explain over 80% of the variation in the data.

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Θεματική Συνεδρία V: Ανόργανα υλικά - Κεραμικά και υαλώδεις ύλες

Characterising pottery production and importation in Early Bronze Age Troy: preliminary results from thin-section petrography

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Abstract

Troy constitutes one of the most discussed sites within Mediterranean and Aegean archaeology, particularly during the Bronze Age. It has been especially prominent in discussions about its Mycenaean past and the Trojan War, and it has extensively been celebrated for its mythical and historical dimensions. However, despite having been systematically excavated and thoroughly researched and published by German and American archaeological teams for the past 150 years, since its discovery by Heinrich Schliemann in 1870, the lack of previous analytical, laboratory-based studies of pottery (Felts, 1942; Kibaroglu & Thumm-Doğrayan, 2013) from the Early Bronze Age (EBA) strata is intriguing.

This paper presents preliminary results from the study and analysis of a part of Schliemann's legacy material (Easton, 2002) kept at the National Archaeological Museum at Athens, with the aim to determine and characterise the local ceramic production and to explore the question of connectivity with the Aegean and Anatolian world. The study of pottery includes the petrographic analysis of 45 samples, selected on the basis of their macroscopic variation that allowed the distinction between local products and imports. The preliminary results have revealed a diachronic variation of local raw material recipes in the manufacture of pottery, in addition to newly-recognised fabrics that suggest the movement of vessels from the central and southern Aegean, thus contributing to discussions on the role of Troy's strategic location in connectivity networks during the 3rd millennium BC.

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Investigating ancient pottery technology: assessment of maximum firing temperature in prehistoric Poliochni

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Abstract

Firing is the final and most critical stage in the pottery manufacturing process, during which the vessels acquire irreversible physicochemical properties and characteristics. Our research aims to investigate aspects of prehistoric firing technology combining various analytical techniques, thus proposing an integrated interdisciplinary methodology for the study of ancient pyrotechnology. The prehistoric settlement of Poliochni in Lemnos serves as an excellent case study, presenting habitation from mid 5th to the end of the 2nd millennium BCE. A set of analytical techniques, some of which tested on prehistoric Aegean material for the first time, was applied on twelve representative sherds of all habitation phases, in order to estimate maximum firing temperatures. The samples were subjected to a) petrographic analysis, b) Fourier transform infrared spectroscopy (FTIR), c) magnetic susceptibility measurements, and d) thermoluminescence (TL). The validity and resolution cross-check of each method's results led to tailoring of the most fitting methodological approach to investigate ancient firing technologies. The analyses results showed that the majority of the samples were fired in fully oxidizing atmosphere and the maximum firing temperature reached levels of the order of 750°C. Only one sample was fired at considerably higher temperature (*ca.* 850°C), and at least another one at fairly lower temperatures (<700°C). The cross-check of each method's results, regarding maximum firing temperature estimate, was in accordance for 90% of the analyzed samples, thus confirming the reliability of the specific multi-analytical set and the research value of adopting the proposed integrated approach.



Archaeometrical investigation of figurines from the ancient cemetery in Sindos, western Thessaloniki, Greece

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Abstract

This study presents an archaeometric investigation of the figurines from the tomb 55 of the ancient cemetery of Sindos, excavated by the Ephorate of Antiquities of the Thessaloniki Region. The archaeological research in Sindos brought to light an important cemetery with a total of 121 tombs. All graves were richly endowed with clay and metal objects. These grave offerings show that the settlement to which the cemetery belonged, flourished in the last quarter of the 6th and at the beginning of the 5th century BC (archaic period). During cleaning small amounts of loosely held pigments and their traces trapped in the soil material were collected. These tiny grains of the order of 0.1-0.5 mm serve as samples for the analytical procedure. More specifically, the materials and techniques used to make the figurines are thoroughly investigated: the clay of the body is examined, the main ingredients of the preparation and the pigments are also identified. The applied examination techniques include: visual observation of the samples with a stereomicroscope and examination of thin sections with a polarized light microscope. So initially, to identify the main pigments (the minerals responsible for the color) their optical properties are examined: color, pleochroism, texture, refractive index, birefringence, polarization color, extinction, etc., using polarized optics microscopy. In addition, physicochemical analysis of the above-mentioned samples was implemented by m-XRF, SEM-EDX, FTIR and m-Raman. In general, the following inorganic pigments were identified: Chalk- Calcite, Red Ocher- Hematite, Vermilion- Cinnabar, Yellow Ocher- Goethite, Egyptian Blue-Cuprorivaite and Coal. Gum Arabic was used as an organic binder. The main ingredient of the preparation was kaolinite. In addition, the results of the analyses of the Sindos figurines are compared with the archaeometric data from figurines and wall paintings from other Macedonian monuments.

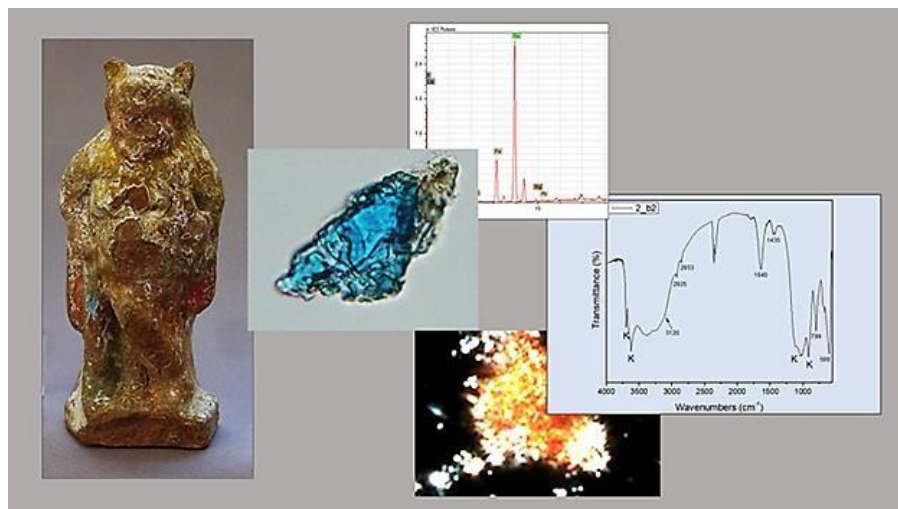


Fig.1. Ancient figurine Hercules. PLM, XRF and FTIR spectra from yellow grains. The presence of kaolinite, yellow ocher and gum Arabic was found. PLM of Blue Cuprorivaite.

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Non-destructive investigation of corrosion patterns in vitreous Mycenaean materials

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Abstract

Vitreous materials suffer a great degree of degradation, with the smaller objects, such as beads and relief plaques, constituting the largest set of artefacts retrieved in earlier contexts, being particularly vulnerable. Such materials often show complex corrosion patterns on their surface when they are exposed to burial environments (Jackson, Greenfield and Howie, 2012). There are two primary factors to be taken into consideration concerning corrosion, namely, the chemical composition/the production technology of the object, and the depositional environment (Panagiotaki, 2008 and Rehren 2008).

In this case study, a set of vitreous materials from Mycenaean contexts in the Aegean has been analyzed, non-destructively by means of LED microscopy, micro-XRF and RBS, to investigate the corrosion products on their surface, the corrosion process and its development, and perform evaluation of their preservation state. Distinguishing the siliceous body of the objects from the corrosion products in this study proved challenging (Regt, Megens and Eijck, 2019).

This research aims to address technological and material science questions concerning the degradation mechanisms at different spatial dimensions, within the surface layers. The results of this analytical approach identified the main corrosion patterns: a. Discoloration caused by Mn and Fe Browning, b. Lamination c. Flaking d. Iridescence and e. Enamel-like opaque effect f. Chalk-like texture.

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Μελέτη αρχαιολογικής φαγεντιανής με Φασματομετρία Φθορισμού Ακτίνων Χ: Τεχνολογία και παραγωγή

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Περίληψη

Έντεκα υαλώδη δείγματα μελετήθηκαν με εφαρμογή της Φασματομετρίας Φθορισμού Ακτίνων-Χ (Micro X-ray Fluorescence, μ -XRF) στο εργαστήριο XRF του Ινστιτούτου Πυρηνικής και Σωματιδιακής Φυσικής του ΕΚΕΦΕ «Δημόκριτος». Στόχος ήταν η μελέτη της τεχνολογίας κατασκευής και η απόπειρα αποτίμησης της πιθανής προέλευσης των δειγμάτων, μέσω του προσδιορισμού της χημικής τους σύστασης.

Τα δείγματα προέρχονται από τον αρχαιολογικό χώρο των Μυκηνών και χρονολογούνται από τα συνευρήματα στην Ύστερη Εποχή του Χαλκού (ΥΕΙΙΙ-ΙΙΒ). Η έρευνα εστιάζει εκτός από τον προσδιορισμό των πρώτων υλών, στην αξιολόγηση της τεχνολογίας παραγωγής και στη διερεύνηση της προέλευσης των δειγμάτων, ενώ παράλληλα μελετάται το φαινόμενο της διάβρωσης, καθώς τα δείγματα παρουσίαζαν σημαντική μακροσκοπική αλλοίωση. Στη μελέτη χρησιμοποιήθηκε και ένα σύνολο 18 μη διαγνωστικών δειγμάτων της Υστερομινωικής περιόδου για συγκριτικούς λόγους.

Προαπαιτούμενη για την εξαγωγή ασφαλών αποτελεσμάτων υπήρξε η αποτίμηση της εκτενούς διάβρωσης, η οποία επηρεάζει καίρια τόσο τη μακροσκοπική εικόνα των δειγμάτων, όσο και τη χημική τους σύσταση. Η χημική ανάλυση τεκμηρίωσε τη διάκριση των αντικειμένων σε φαγεντιανή, γυαλί και αιγυπτιακό μπλε.

Τα αποτελέσματα έδειξαν ομοιότητες στην τεχνολογία κατασκευής των δειγμάτων με την τεχνολογία που χαρακτηρίζει τη μινωική φαγεντιανή. Ο συνδυασμός συγκεκριμένων χρωματοφόρων στοιχείων (Mn, Fe, Cu) που εμπίπτουν στο μινωικό χωρόχρονο εντοπίστηκε σε σημαντικό ποσοστό του υλικού μελέτης (1). Παράλληλα, η μελέτη ιχνοστοιχείων ανέδειξε διαφορετική πηγή πρώτων υλών αλλά και τεχνολογία κατασκευής μεταξύ των δειγμάτων, υποδηλώνοντας την πιθανή ύπαρξη τοπικών εργαστηρίων παραγωγής.

Βιβλιογραφία

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Θεματική Συνεδρία: Ανόργανα υλικά - Μέταλλα

Φυσικοχημική διερεύνηση παλαιομεταλλουργικής δραστηριότητας κατά την Ελληνιστική

περίοδο στο Κάστρο της Μύρινας στη Λήμνο

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Περίληψη

Στη χερσόνησο του Κάστρου της Μύρινας, στη Λήμνο, η διεξαγόμενη, με την άδεια της Ελληνικής Αρχαιολογικής Υπηρεσίας, του Τοπικού Συμβουλίου Μνημείων Νήσων και του Ελληνικού Υπουργείου Πολιτισμού, αρχαιολογική έρευνα των λαξευμάτων και βραχογραφιών, περιέλαβε, κατά την περίοδο 2002-2007, την διερεύνηση ορισμένων ζωνών που σχετίζονται με επιλεγμένους λαξευμένους βραχώδεις σχηματισμούς και κατασκευές, επιτρέποντας τη συλλογή ποικίλων κινητών ευρημάτων. Οι χρονολογικές περίοδοι που μαρτυρούνται μέχρι σήμερα εκτείνονται κυρίως από την εποχή του Χαλκού έως την ελληνιστική και τη ρωμαϊκή εποχή.

Τα δείγματα της παρούσας μελέτης βρέθηκαν σε τομείς στο εξωτερικό του μεσαιωνικού φρουρίου και εξετάστηκαν με SEM/EDS, XRD και XRF με σκοπό τη διερεύνηση της σύστασής τους και στοιχείων σχετικά με την επεξεργασία και τη χρήση τους. Οι αναλύσεις αφορούν σε τέσσερα (4) δείγματα, σκωριών σιδήρου και τοιχωμάτων κλιβάνου, που βρέθηκαν σε δύο διαφορετικούς τομείς του Κάστρου. Η παλαιομεταλλουργική αυτή δραστηριότητα μαρτυρείται σε ζώνες με δείγματα άνθρακα που χρονολογήθηκαν με την μέθοδο του ¹⁴C στην Ελληνιστική περίοδο, όπως επιβεβαιώνεται και από κινητά ευρήματα, και ενδέχεται να υποδηλώνει in situ παραγωγή σιδήρου.

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Θεματική Συνεδρία: Βιοϋλικά και οργανικά κατάλοιπα

The effect of pH, temperature and time on the dissolution behaviour and composition of microscopic SiO₂-rich phytoliths: results from long-term batch laboratory experiments

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Abstract

The biominerals produced in plant tissues, microscopic SiO₂-rich phytoliths (SiO₂·nH₂O) included, have been studied extensively because of the useful information they may provide on the natural and anthropogenic environment. Biogenic silicon is among the earliest known natural bioskeletons and its unique physicochemical properties make it a suitable material for a wide range of applications in geosciences and archaeology. Although the study of phytoliths is an internationally emerging field, recent studies on phytoliths have not put emphasis on the investigation of their stability in relation to the biogeochemical depositional environment and on the preservation of their morphotypes, in conjunction with important environmental parameters such as soil pH, temperature and water availability. Furthermore, the extent at which the presence of other chemical elements affects the dissolution of biogenic silicon, and thus the preservation of phytoliths in geoarchaeological contexts, such as soils, sediments and artefacts (e.g. plant-tempered ceramics) has been scarcely covered. The present study aims to contribute to the lack of research outlined above and to broaden this field of study. In particular, the dissolution mechanism of phytoliths is investigated in relation to variations of pH, temperature and time, by the means of long-term batch laboratory experiments. Moreover, the mobility of silicon (Si) and other seven main and trace chemical elements (K, Mg, Al, Ca, Fe, Sr, Br) was studied with inductively coupled plasma mass spectrometry (ICP-MS) and data was processed with MATLAB software. For the high resolution characterisation of phytolith morphology, mineralogy and chemistry, a variety of complementary analytical techniques were employed (OLM, SEM/EDS, XRD, ED-XRF, FTIR, TGA-DTGA, CHNS). The comprehensive analysis of phytoliths contributes to the understanding of the biogeochemical cycle of silicon and to the geoarchaeological research, through the insights gained on the post-depositional alteration of the SiO₂-rich phytoliths over time, and its relationship to the mobility of other chemical elements. The overall analysis of fresh phytoliths extracted from wheat (*Triticum* spp.) provided insights on the phytolith preservation state and factors that control release of the occluded chemical elements. These may further contribute to the study and interpretation of aged phytoliths in palaeontological and archaeological sites. Future work on phytoliths, besides other tasks, will include systematic attempt for individual age assessment.

Keywords: SiO₂-rich phytoliths, dissolution, biogeochemical mobility of chemical elements, Archaeological Science



Histomorphometric method for age-at-death estimation on cremated human bones

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Abstract

Age estimation on cremated individuals is a challenging task because high temperatures (>300°C) prevent standard anthropological methods to perform efficiently. Up to date, histomorphological/metric methods can estimate age-at-death of inhumed individuals with standard estimation error of ± 3 -15 years, whereas the application of these methods on cremated individuals exhibit a high estimation error (>10 years). In this study, we present a new histomorphometric age estimation method based on an osteon population density (OPD) regression equation. For this, we used unburned femur samples from modern individuals of known age and sex (n=30) from forensic cases resulting on standard estimation error of ± 3 years. To make it effective for cremated bones we experimentally cremated partially femur cross-sections from the same modern individuals (n=23) at different temperatures (>300°C) using high temperature muffle furnace (CWF). The analysis of the experimentally cremated bones included measurements of the dimensions and occupation area (mm²) of the same microstructures as the unburned bones *i.e.*, secondary osteons and osteon fragments, aiming to estimate the percentage of shrinkage of bone microstructures and calculate the OPD values. For every individual we applied mathematical correction of the OPD value by subtracting the extra density (mm²) of the microstructures having resulted from the shrinkage, restoring the initial density number of osteons before cremation. The preliminary results suggest that this modification of the values provides more accurate age estimations for cremated individuals.



Comparative histological approach of inflammatory reactions in three possible cases of treponematoses identified in human skeletons of 15th-19th centuries from Iasi, Romania

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Abstract

During the archaeological excavations carried out in 1995 at the Romano-Catholic Cathedral from Iasi city (Romania), three human skeletons (15th-19th centuries) with pathological modifications suggestive for treponematoses (including *caries sicca*), were discovered. The human remains belonged to adults – two females (M40 and R30) and one male (R26).

Although the past human diseases have been intensely studied by means of macroscopic analysis and non-invasive imaging methods, the histologic analysis of the bones affected by treponematoses has not yet been addressed at the same scale (Assis et al., 2015). The aim of this study is to describe and compare the paleohistological features (periosteal new bone formation – PNB, and compact bone tissue) in the humerus bone affected in all the three skeletons by treponematoses, using different types of light microscopy. Considering the comparative approach of this study, the sampling was performed in the same area of the bone to ensure anatomical and biomechanical similarity. The bone samples were subjected to the histological examination methodology and histotaphonomical evaluation (Brönnimann et al., 2018).

The results show that the bone samples are moderately preserved. Two patterns of the PNB were identified, one for the M40 and R30 skeletons – characterized by bone resorption lacunae, having a more continuous and accentuated development, and one for the R26 skeleton – characterized discontinuous and reduced development. The cortical area of the M40 and R30 samples is described by osteons, interstitial lamellae, areas of bone resorption and Howship lacunae, while the R26 compact bone morphology is characterized by a reduced number of osteons and high number of cavities. This is probably correlated with the increase of porosity more likely produced by an inflammatory result of the compact bone (osteitis).

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Investigating dietary patterns in the ancient colony of Abdera (Aegean Thrace, Greece). Stable isotope analysis ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) in human bone collagen.

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Abstract

During the second Greek colonization (8th – 5th c. BC) numerous of colonies were founded across the Aegean region. Abdera is a renowned and prominent colony located in the littoral of Aegean Thrace. The geostrategic location in addition to fertile land and mineral resources turned Abdera into a notable commercial and political international hub, during classical times. The colony shows a unique case of two-wave colonization. The city was initially founded *ex nihilo* by Ionians from Clazomenae (c.655 BC). Due to harsh environmental and political conditions, the Clazomenian endeavor did not last in time and the city was successively re-founded about one century later (545 BC) by a new group of settlers from another Ionian city, Teos. Within these circumstances, previous anthropological research shows a high frequency of malnutrition expressed with the prevalence of infections and metabolic diseases in the population of Abdera, during its initial occupation phase (archaic period). In this study, we present a diachronic dietary reconstruction from the ancient city of Abdera. We apply the established method of stable isotope analysis ($\delta^{15}\text{N}$, $\delta^{13}\text{C}$) in bone collagen of 74 human skeletons from the cemetery of ancient Abdera. The sample has a vast chronological range beginning with the two phases of the city's foundation and refoundation (archaic period) and extends to the Roman era.

Our dataset consists of carbon and nitrogen isotope values from adults (n= 33, 17 males, 12 females, 4 n.d), subadults (n= 31), and unident. ind. (n=10) dating to the Archaic (n=13), Classical (n=17), Hellenistic (n=19) and Roman (n=20) period. Our results show a diachronic preference in terrestrial animals during both periods with lesser contribution of C3 plants and marine resources. Our pilot observations depict a diachronic trend of the dietary habits in Abdera and offer a window to the dietary differentiation during historically diverse periods.



Past lives of ladies in Medieval Moldova: multidisciplinary approach of a female skeleton exhumed from a necropolis of 16th-17th centuries, in Iasi, Romania

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Abstract

This study is focused on a female skeleton, discovered in 2021, in the necropolis of 16th-17th centuries, at the "Vovidenia" Church in Iasi (Romania). According to the funerary stone, the skeleton belonged to a female personality of the times from the medieval Iasi, the former capital of Moldova. The study refers to multiple investigations based on paleoanthropological (e.g., age at death and sex estimations, osteometry), taphonomic and palaeopathological evaluations, dental wear and non-metric traits, all integrated in the archaeological context.

All teeth surfaces were examined and digitized using a Zeiss Stemi 305 stereomicroscope with a Canon Power Shot G9 attached. The degree of dental wear was assessed by the semiquantitative scoring system (Scott, 1979, Smith, 1984). The evaluation of dental traits and scores were based on the Arizona State University Dental Anthropology System (ASUDAS) (Turner, 1991).

The analysed human remains belonged to a buried female with the age at death of 35-40 years old. The preservation status of the skeleton is satisfactory. At the level of the skull and of the distal epiphyses of the humeri there are traces of oxidation. Linear enamel hypoplasia (LEH) is present at the level of the upper left lateral incisor (I²), canine, first premolar (P¹) and lower right canine. Dental caries (2nd degree) affected the lower left first molar (M₁). The dental wear scoring method shows a reduced occlusal/incisal dental wear. The non-metric traits identified on the upper teeth are: shovelling on central incisor, tuberculum dental on upper lateral incisors, and Bushman tubercle on the canine. Other traits making this skeleton distinctive are represented by the supernumerary cusps.

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Assessing biological distance among medieval human populations from Eastern Romania

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Abstract

The features of the dental crown, including shape and non-metric traits, are largely heritable and to a small extent influenced by the environment (Marado et al., 2013). Therefore, the teeth represent an ideal material for the studies on biological distance between archaeological human populations (biodistance). Such studies are based on morphological differences in the skeleton or dentition, both metric, shape and non-metric traits.

We propose to analyze affinities between medieval human populations of Eastern Romania, using as bioindicator the lower second molar. The dental material samples dated to the 16th-19th centuries, comes from several archaeological sites of Eastern Romania. The methodology consists of correlating the geometric morphometrics with the evaluation of non-metric dental traits. The bidimensional data were collected using a set of landmarks located on the occlusal surface and its periphery (Bookstein, 1997), and the non-metric traits were scored according to the ASU system (Scott, 1979).

The dental shape, the sizes of the cusps, and the intercuspidal grooves highlight particularities for a series of samples. Also, dental morphotypes determined by sexual dimorphism are described. For males it was found that the lower second molar is elongated in the mesial plane, and it covariates with the model of the grooves (x and y type), while for females it was obvious the groove + type associated with mesiodistal flattened molars. The trends in the dental shape, the way in which the shape covaries with the non-metric characters, and the measure / degree of morphological similarity are all described in this paper, contributing to the phenotypic picture reconstruction of medieval human populations in Eastern Romania.

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Urbanization from a population genetics perspective in Thessaloniki between 300 BC and 1500

AD

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Abstract

Urbanization stands as one of the most significant processes in the demographic history of humanity. It presents opportunities for the intensification of human interactions, fostering socioeconomic and cultural advancements. As cities expand, they often experience an influx of immigrants from other regions, shaping the genetic structure of the urban population. The changes in population density impact the strength of genetic drift, while the arrival of new residents from diverse regions increases gene flow and enhances the genetic diversity within the city. Additionally, urbanization creates novel environmental conditions that give rise to altered selection pressures. However, few studies have explored these phenomena from a population genetic perspective, particularly in historic urban centers.

In our study, we delve into these processes in Thessaloniki, a metropolis in northern Greece founded in 315 BC. Thessaloniki played a pivotal role as a bridge between the Roman West and the Byzantine East, influencing the Roman, Byzantine, and Ottoman Empires. We analyzed whole genome sequenced data from 42 individuals spanning the period from 300 BC to AD 1500. Employing state-of-the-art methods such as PCA, ADMIXTURE, f-statistics, runs of homozygosity, and IBD analysis on imputed phased genotypes, we unravel the genetic landscape of Thessaloniki.

Notably, we observed a shift towards western European genetic ancestry, alongside an increase in the genetic diversity within the city. The presence of individuals with evident origins from distant regions suggests mixing of populations with diverse backgrounds, driven by heightened migration rates. Surprisingly, despite the heightened genetic variability, we identified cases of high endogamy levels. This observation, coupled with the presence of shared IBD segments, implies the existence of an underlying social structure, which contrasts with the city's multicultural character. Overall, our study contributes to the understanding of population genetics within historic urban centers and the complex interplay between urbanization, migration, and genetic diversity.



Θεματική Συνεδρία: Θετικές Επιστήμες στη Συντήρηση

Μελέτη κατάστασης διατήρησης και συντήρησης σιδηρών ευρημάτων γεωμετρικών και αρχαϊκών χρόνων

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Περίληψη

Η παρούσα εργασία μελετά 30 μαχαίρια από ένα μεγαλύτερο σύνολο σιδηρών αντικειμένων, συγκεκριμένα τα ευρήματα αυτά είναι συνολικά τέσσερις χιλιάδες τετρακόσια και ποικίλουν τυπολογικά και στο μέγεθος, τα οποία χρονολογούνται στη γεωμετρική και αρχαϊκή εποχή και παρουσιάζουν ιδιαίτερο ενδιαφέρον, όχι μόνο για το μεγάλο τους όγκο, αλλά κυρίως για την εξαιρετική κατάσταση διατήρησης στην οποία βρίσκονται.

Σκοπός της διερεύνησης είναι ο σχεδιασμός και η εφαρμογή ενός επαρκούς και επιστημονικά τεκμηριωμένου πρωτόκολλου συντήρησης που θα οδηγούσε στα καλύτερα και ταχύτερα αποτελέσματα, δεδομένου του πλήθους των αντικειμένων. Για τη δημιουργία ενός βιώσιμου πρωτόκολλου είναι απαραίτητη η κατανόηση των αναγκών και των προβλημάτων σε συσχέτιση με την αρχαιολογική και τεχνολογική αξία των αντικειμένων και η διατύπωση ερευνητικών ερωτημάτων σε σχέση με την τεχνολογία κατασκευής, την 'αυθεντική' επιφάνεια και την παθολογία σε συσχέτιση με το ανασκαφικό περιβάλλον.

Ως εκ τούτου σχεδιάστηκε μία επιστημονική μεθοδολογία προσέγγισης για την εξέταση και την ανάλυση ενός 'στρωματογραφικά' επιλεγμένου δείγματος, το οποίο εξετάστηκε ενδελεχώς ένα μικρό σύνολο μελετήθηκε υπό τη χρήση μικροσκοπίου, με μικροσκόπιο για την καταγραφή των ιδιαίτερων μορφολογικών και τεχνολογικών χαρακτηριστικών και της στρωματογραφίας των εδαφικών εναποθέσεων και των προϊόντων διάβρωσης. Ακολούθησε διαγνωστική εξέταση και ανάλυση με ραδιογραφία ακτίνων Χ (X-Ray), με φασματοσκοπία φθορισμού ακτίνων Χ (p-XRF), με φασματοσκοπία περίθλασης ακτίνων Χ (XRD) και με υπέρυθρη φασματοσκοπία με μετασχηματισμό Fourier (FTIR).

Η αξιολόγηση των αναλυτικών δεδομένων παρείχε επαρκή και κατάλληλα δεδομένα για το σχεδιασμό και την εφαρμογή των επεμβάσεων συντήρησης. Ο αριθμός των αντικειμένων που συντηρήθηκαν ήταν συνολικά 1800. Τα αντικείμενα συντηρήθηκαν κυρίως με μηχανικά μέσα και ύστερα πραγματοποιήθηκαν επιλεκτικές επεμβάσεις σταθεροποίησης και προστασίας του συνόλου. Τέλος, προσδιορίστηκαν οι κατάλληλες συνθήκες αποθήκευσης και έκθεσης ολοκληρώνοντας το πρωτόκολλο συντήρησης.

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Interpretive approaches in the investigation of a field telephone from the Marathon Lake

Museum

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Abstract

This study focuses on the presentation and evaluation of the results obtained during the investigation and conservation of a field telephone from Marathon Lake Museum regarding a) its manufacturing materials, as presented in the user manual and b) its use during the construction of the Marathon Dam at the beginning of the previous century. The phone consists of a fabric case which contains the operating mechanism (metal alloys) and the headset (synthetic polymer) and was manufactured in the USA in the first half of the 20th century to serve the communication needs of the US Army (Thompson & Harris 1991).

For the comprehensive study of the field telephone Optical microscopy (OM), X-ray Fluorescence (XRF) Fourier Transform Spectroscopy with Total Reflection Absorption (ATR - FTIR) and Scanning Electron Microscopy with Energy Dispersive X-ray Spectroscopy (SEM - EDS) were used. This methodology helped in identifying the manufacturing materials of the individual parts of the field phone: cotton fabric (case and carrying strap), brass and zinc (metal frame of the operating mechanism) and bakelite and cellulose acetate (headset). At the same time antimony was identified in the fabric case, indicating the use of antimony trioxide as a flame retardant (Touval 1993: 941-953), as well as a coating of PVC resin used for waterproofing and protection (Shashoua 2008:35).

The seal of US armed forces Signal Corps and the registration number revealed during the treatment of the field telephone, as well as the date and manufacturing company of the headset "10/1943", "Western Electric & Co", confirmed its origin and initial use during World War II. These finds and the metal label on the case, links the period of use of the field telephone with the additional expansion and upgrade works of the existing network undertaken by the Hellenic Water Company, from 1931 onwards (Hekimoglu 2014:167, 189, 198-199).

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The use of nanostructured fluids and gels for the cleaning of coated painted surfaces: A Physicochemical assessment for the removal of Paraloid B72 from wall paintings

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Abstract

Acrylic resins are widely used in conservation practice, including interventions for coating, facing, and consolidation treatment. The removal of such polymers is often challenging, especially when applied on painted surfaces and porous substrates, as in the case of wall paintings. Although organic solvents and mixtures can solubilize the resins to a certain extent - even aged ones, - when applied to porous materials they may diffuse in their structure entraining also the polymer deeper into the substrate. Furthermore, the paint layers and especially the organic binder can be affected during the cleaning process, compromising the physical and aesthetic integrity of the paintings.

The present study aims at exploring the cleaning application and efficacy of five nanostructured fluids recently introduced in the conservation community, namely Nanorestore Cleaning® Polar Coatings B, G, S, and the Nanorestore Cleaning® Apolar Coating. The cleaning agents were tested for the removal of Paraloid B-72 from ochre-based egg tempera paint films on calcitic mortar support. The nanofluids were tested, applied neat, and compared with the use of organic solvents. Additionally, nanofluids confined in hydrogels, such as a poly(vinyl alcohol) network hydrogel (Nanorestore Gel® Peggy 5) and a chemical hydrogel based on a pHEMA/PVP (Nanorestore Gel® Medium Water Retention – MWR) were tested [1].

Mockups of coated and artificially aged wall painting samples were used for the cleaning tests. The cleaning results were assessed using optical microscopy (OM), gloss and color measurement, and Reflection Infrared (FTIR) spectroscopy. Useful information was obtained about the cleaning mechanism of the two different types of gels, combined with the five nanofluids. The study outlines the importance of tailoring the cleaning application method, to reach satisfactory results.

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