

**EUROPEAN
MEETING
ON ANCIENT
CERAMICS**

**EM
AC**

**16-18 Sep.
Barcelona
2019**



EUROPEAN MEETING ON ANCIENT CERAMICS

**16-18 Sep.
Barcelona
2019**

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VENUE



Venue:
Faculty of Geography
and History



Metro:
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L1



Street:
Montalegre, 6



Street:
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Restaurant
En Ville:
Dr. Dou, 14



Les
Rambles



4th floor

Oral sessions

Poster instruc- tions

Oral sessions will take place in the **Sala d'Actes**.

The **poster area** will be located in the **4th floor** corridors.

Coffee breaks will be held on the **4th floor**.

Please ensure all **oral presentations** are uploaded and ready before the session starts.

Presentations should last **10 minutes** followed by **5 minuts for discussions**.

Poster Session 01

Posters should be displayed by **Monday 16 at 11.00. Poster Session 01 starts at 11.30**. Posters need to be removed before lunch time the following day (14.15 on Tuesday)

Poster Session 02

Posters should be displayed by **Tuesday 17 at 15.15. Poster Session 02 starts on Wednesday at 11.00**. Posters need to be removed in the afternoon.

Lunch

Wifi

Confer- ence dinner

Smoking

Fire or evacuation procedure

Ground floor

Lunch will be served in the **Sala de Juntres**.

We have 3 different WiFi accesses:
WIFI UB

1. ID: AYMVB.B.TMP

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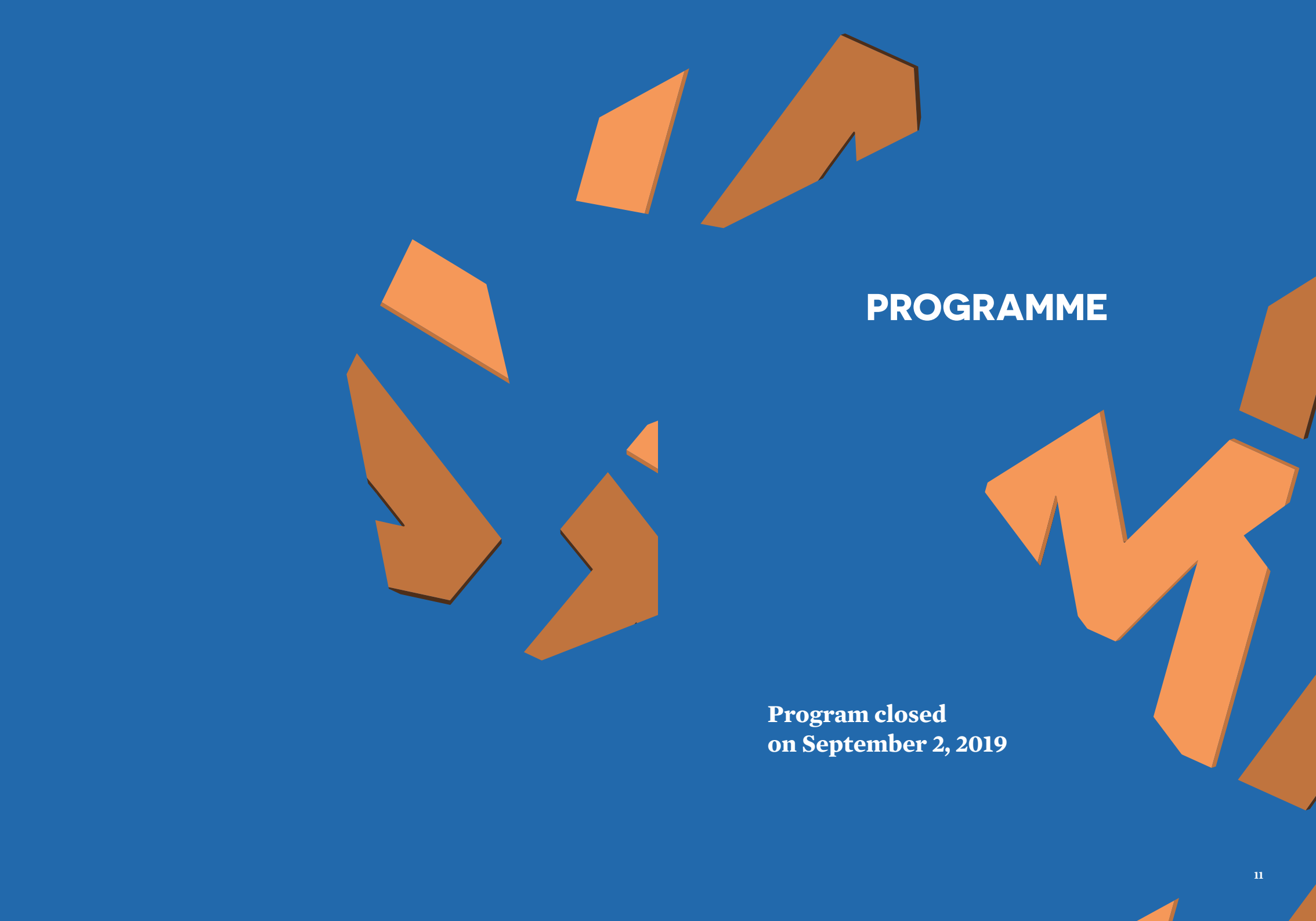
Restaurant En Ville

Carrer del Dr. Dou, 14, 08001 Barcelona
Tuesday 17 at 21.00.

Booking and advance payment is necessary to attend the dinner. Ask the Secretariat if there are still places availables.

Smoking is not allowed.

The UB has an emergency plan. In the event of an emergency, **participants should follow the signs and instructions from staff**.

The background is a solid blue color. Scattered across the page are several abstract, three-dimensional geometric shapes in shades of orange and brown. These shapes resemble stylized, angular letters or fragments of a larger structure. Some are positioned near the top, some near the bottom, and others are more centrally located. The word 'PROGRAMME' is printed in white, bold, uppercase letters in the upper right quadrant.

PROGRAMME

**Program closed
on September 2, 2019**

Session 01

Provenance and networks

Chair: Daniel Alberio

8.00-9.00	Registration
9.00-9.30	Welcome and opening conference
9.30-9.45	Chemical Analysis of Middle Bronze Age pottery complex from the site of Grotte di Marineo – Sicily (Italy) Giuseppe Politi, Anna Maria Gueli, Orazio Palio, Maria Turco, Stefania Pasquale, Giuseppe Stella, Quentin Lemasson, Claire Pacheco, Laurent Pichon, Brice Moignard
9.45-10.00	Middle Bronze Age cult hypogea of Trinitapoli (FG, Italy): pottery as a proxy for social interaction in the Tavoliere Italo M. Muntoni, Rachele Modesto, Giacomo Eramo
10.00-10.15	Tracing the Provenance of Red Lustrous Wheel-Made Ware (RLW): Petrographic, Geochemical and Sr-Nd Isotope Analysis Mustafa Kibaroglu, Ekin Kozal, Andreas Klügel, Gerald Hartmann, Patrick Monien
10.15-10.30	Wine Roman amphorae from Cap Béar 3 shipwreck (Port Vendres). Assessing the beginning of the maritime trade between Hispania Citerior (NE Spain) and Gallia Narbonensis (S France) Verónica Martínez Ferreras, Corinne Sanchez, Michel Salvat, Marie-Pierre Jézégou, Inga Sánchez Peris

Session 02

Provenance and networks

Chair: Yona Waksman

10.30-10.45	Provenance studies of amphora production and trade patterns along the Eastern Adriatic coast in Pre-Roman period Maja Mise, Patrick Quinn
10.45-11.00	Provenance analysis of Punic amphorae found at Corinth: shedding new light into long-distance salt-fish trade networks in the 5th century BC Leandro Fantuzzi, Evangelia Kiriatzi, Antonio M. Sáez Romero, Noémi S. Müller, Charles K. Williams
11.00-11.30	Coffee break
11.30-12.30	Poster Session 01
12.30-12.45	400 Years of Cooking Wares at Priene: Tracing Trade and Technological Networks in the Ancient Mediterranean Silvia Amicone, Noémi S. Müller, Gerwulf Schneider, Christoph Berthold, Lars Heinze, Nina Fenn, Svenja Neumann, Evangelia Kiriatzi
12.45-13.00	Changes in Production Traditions of Cooking Pots during the Iron Age in the Southern Levant David Ben Shlomo

13.00-13.15	Spatial Patterns of the ceramic production in Colonia Augusta Achaica Patrensis Nickoula Kougia, Helen Simoni, Paul Reynolds, Ioannis Iliopoulos, Vayia Xanthapoulou, Aikaterini-Maria Pollatou
13.15-13.30	Multidisciplinary characterisation of African amphorae and Red Slip Ware from the Roman city of Thaenae (Tunisia) Rémi Rêve, Jean-Paul Ambrosi, Claudio Capelli, Abdelhamid Barkaoui, Michel Bonifay, Ammar Othman
13.30-13.45	The production of lead glazed tablewares in late medieval Italy and their exportation to Latin Greece: New considerations on 14th-century contexts from Corinth, Peloponnese Florence Liard, Guy Sanders, Ayed Ben Amara, Bernard Gratuze, Stéphan Dubernet, Rémy Chapoulie , Evangelia Kiriati
13.45-14.00	Under the estuary of Aveiro: a 15th century shipwreck and its cargo of ceramics Uxue Sanchez-Garmendia, Jose Bettencourt , Ines Pinto Coelho, Ricardo Silva, Gorka Arana, André Teixeira, Javier G. Iñáñez
14.00-15.00	Lunch

Session 03

Provenance and networks

Chair: Mohammadamin Emami

15.15-15.30	Did the student become the master? The development of the glaze technology in Cyprus during the 13th to 17th centuries AD Carmen Ting, Athanasios Vionis, Vasiliki Kassianidou, Thilo Rehren
15.30-15.45	From Pastes to Glazes: Assessing Provenance and Technology of Islamic Glazed Vessels from Ancient Termez (Southern Uzbekistan) Agnese Fusaro, Judit Molera, Verónica Martínez Ferreras, Trinitat Pradell, Josep M. Gurt Esparraguera, Enrique Ariño Gil, Shakir Pidaev
15.45-16.00	Early Celadon in North China: Compositional Characteristics and Technological Transmission Shan Huang, Ian C. Freestone
16.00-16.15	Early domestic production of lead-glazed earthenware in Japan: Analytical studies of excavated ceramics from the 7th and 8th centuries Junko Furihata
16.15-16.30	Ceramic Production Technologies and Ancient Interaction Networks of Multi Ethnic Communities at Multi-Component sites of the Átúres Rapids, Middle Orinoco, Venezuela Natalia Lozada-Mendieta, Patrick Quinn, José R. Oliver
16.30-17.00	Coffee break

Session 04

Ceramic as building materials

Chair: Irmagard Hein

17.00-17.15	Evaluation of nano-lime dispersions as swelling inhibitors for the protection of clay-based building materials Anastasia Michalopoulou, Pagona Maravelaki, Vassilis Kilikoglou, Ioannis Karatasios
17.15-17.30	The manufacture and distribution of tiles in Classical Chalkidike: a geo-chemical and petrographic study of the ceramic building economy Elena Cuijpers
17.30-17.45	Ceramic Pipes of the Roman Aqueduct from raiano Village (L'Aquila, Italy): A technological Study Laura Medeghini, Vincenzo Ferrini, Francesca Di Nanni, Francesco D'Uva, Silvano Mignardi, Caterina De Vito
17.45-18.00	Technological study of early 20th century mud bricks Maria Amenta, Dimitra Koumpouri, Vassilis Kilikoglou, Ioannis Karatasios
18.00-18.15	The CLAYONRISK project: bricks manufacturing technologies to increase the built heritage resilience and to raise the common identities of peoples Elena Mercedes Pérez-Monserrat, Lara Maritan

TUESDAY 17 SEPTEMBER

Session 01

Technical ceramics and vessel function

Chair: Anno Hein

9.00-9.15	Shared technological milieus: defining the borders between wheel-made and hand-made pottery production in Early Helladic Argolid Choleva Maria, Kiriati Evangelia, Petropoulos Nikos, Müller Noemi
9.15-9.30	An Interpretation of thermal analyses on some Glass fragments from the city Istakhr to determination about the heating temperature construction of ancient glass Farahnaz Bayatnejad, Mohammadamin Emami, Ahmad Ali Asadi
9.30-9.45	Reading surfaces: on the determination and properties of surface treatments. Towards a better understanding of clay vases function Bastien Rueff, Pauline Debels
9.45-10.00	Fusion cooking pots: an integrated cooking pottery study at the northern edge of the Mycenaean world Anastasia Dimoula, Sophia Koulidou, Zoi Tsirtsoni, Soultana Maria Valamoti
10.00-10.15	Petrographical and geochemical characterizations of the late antiquity unguentarium from the archaeological site of Tripolis, Denizli (southwestern Turkey) Baris Semiz
10.15-11.00	Coffee Break

Session 02

Statistics and databases in ancient ceramic studies: papers in honour of Mike Baxter

11.00-11.30	Talk in honor of Michael Baxter
11.30-11.45	Preserve, enrich, share, interconnect: ongoing developments of the Lyon CERAMO database Yona Waksman, Aybüke Öztürk, Louis Eyano, Valérie Merle, Céline Brun, Marie Delavenne, Jacques Burlot, Alain Bernet, Cécile Batigne Vallet, Bertrand David, Stéphane Lallich, Jérôme Darmont
11.45-12.00	Shot from the Hip – Dealing with imprecise and incomplete data of pottery analyses with portable energy dispersive XRF Anno Hein, Vassilis Kilikoglou
12.00-12.15	Multivariate ‘mixed-mode’ analyses for characterising archaeological ceramics using the cerUB package in R Andreas Angourakis, Verónica Martínez Ferreras, Josep M. Gurt Esparraguera
12.15-12.30	

Next venue proposals

Session 03

Applied decorations

Chair: Javier G. Iñáñez

12.30-12.45	Gloss Chemistry and the Origins of the Corinthian Black Figure Technique Emilio Rodriguez-Alvarez
12.45-13.00	Polychrome glazed ceramics in al-Andalus (9th-12th centuries): methods of production and materials Elena Salinas, Trinitat Pradell, Judit Molera
13.00-13.15	Hyperspectral Imaging assisted by False Color Infrared techniques for ceramic's decoration studies. Achievements and Limitations Athina Georgia Alexopoulou, Agathi Anthoula Kaminari
13.15-13.30	The stability rang of diferent manganese compounds in ancient glazes J. Molera, G. Molina , T. Pradell
13.30-13.45	Reconstructing 17th century Dutch tin-glaze using information from archival and archaeological sources Kate van Lookeren Campagne, Luc Megens, Bert-Jan Baas, Maarten van Bommel
13.45-14.00	Study Gilding decoration on Mina'i ceramic of Rayy and Alamut in Iran based on microscopic investigation and ancient treatise Melika Yazdani, MohammadAmin Emami, Hossein Ahmadi, Farhad Khosravi Bizhaem
14.00-14.15	Study on glaze decoration technology and coloration mechanism of porcelain from Changsha kiln, Tang dynasty (618–907 A.D.), China Qaing Li, Jiming Xu, Heliang Yao, Fan Yang, Yu Liu, Lihua Wang
14.15-15.15	Lunch

Session 04

Development of new methods and techniques

Chair: Rémy Chapoulie

15.15-15.30	Unveiling the Sicilian and Southern-Italian red-figure vases productions and technologies through synchrotron radiation techniques Germana Barone, Paolo Mazzoleni, Antonella Santostefano, Lara Gigli, Mattia Gaboardi, Jasper Rikkert Plaisier, Simona Raneri
15.30-15.45	Image analysis in ancient ceramics characterization and provenance attribution: from optical microscopy to cathodoluminescence microscopy and spectroscopy Eleonora Odelli, Remy Chapoulie, Stefano Pagnotta, Yannick Lefrais, Federico Cantini, Vincenzo Palleschi, Simona Raneri
15.45-16.00	Lead and strontium isotopes and their combination to elemental chemistry to trace ceramic circulation in Mesoamerica Virginie Renson, Hector Neff, Antonio Martínez-Cortizas, David Cheetham, Jeffrey Blomster, Michael Glascock
16.00-16.15	Estimating the Original Firing Temperature of Ceramics Using Biotite Study Karel Slavíek, Dalibor Všíanský
16.15-16.30	Synchrotron radiation through the millennium; High resolution μ-XRPD for characterizing the ceramic's surface generated by heat transfer Mohammadamin Emami
16.30-16.45	Archaeo-ceramic 2.0: investigating ancient ceramics using modern technological approaches Lara Maritan
16.45-17.15	Coffee break

Session 05

Development of new methods and techniques

Chair: Judit Molera

17.15-17.30	Individualised traditions. Tracing out pottery forming techniques through X-ray micro-CT in a pottery assemblage from Middle Neolithic Sesklo (Thessaly, Greece) Jannis Kozatsas, Kostas Kotsakis, Dimitrios Sagris, Konstantinos David
17.30-17.45	A study on mechanical properties of 19th-century glazes from Bordeaux Emmie Beauvoit, Ayed Ben Amara, Nadia Cantin, Rémy Chapoulie, Camille Frugier, Bernard Gratuze, Agnès Smith, Nicolas Tessier-Doyen
17.45-18.00	The automatic recognition of ceramic through only one photo. The ArchAIDE App. Francesca Anichini, Nevio Dubbini, Nachum Dershowitz, Barak Itkin, Lior Wolf
18.00-18.15	New trends in geochemical data grouping: supervised machine-learning methods and full-spectrum analyses Anna Anglisano, Lluís Casas, Marc Anglisano, Ignasi Queralt
20.30	Conference Dinner: Restaurant En Ville Carrer del Dr. Dou, 14 08001 Barcelona

Session 01

Production centres and raw material studies

Chair: Claudio Capelli

9.00-9.15	Ornamental and technological transitions within LBK and from LBK to SBK period (Eythra, Saxony) K. Bente, H. Stäuble, Ch. Berthold, G. Sobott, U. Veit, W. Lottermoser, A. König
9.15-9.30	Pottery production and technological traditions at Neolithic and Chalcolithic Samos, Greece: preliminary data from Kastro-Tigani and Heraion Sergios Menelaou, Ourania Kouka
9.30-9.45	Chalcolithic ceramics from Vila Nova de São Pedro (Lisbon Region – Portugal) – Textural, and chemical analysis Rute Correia Chaves, Augusta Lima, António Monge Soares
9.45-10.00	Potters at the world's end? Pottery production and resilience in Formentera (Balearic Islands, Spain) during the Bronze Age Daniel Albero Santacreu
10.00-10.15	The raw material as an added value of ceramics? Benjamin Gehres
10.15-10.30	Elemental analysis of pottery from the Early and Middle Bronze Age necropolis of Lapithos. The early history of a long-lived production centre in Cyprus Maria Dikomitou-Eliadou, Noémi S. Müller, Marcos Martinón-Torres, Jennifer M. Webb, Agnese Benzonelli, Michael D. Glascock
10.30-11.00	Coffee break

Session 02

Production centres and raw material studies

Chair: Evangelia Kiriati

10.00-12.00

Poster session 02

12.00-12.15

For a “best practice approach” to experimental reproductions of ancient pottery: on-site testing of raw clay with archaeological tools and installations. A pilot study from Bronze Age Crete
Simona Todaro

12.15-12.30

Provenance and Production Technologies of Late Bronze and Iron Age Plain and Drab Ware from Sirkeli Höyük (Cilicia, South Anatolia)
Sinem Hacosmanolu, Mustafa Kibarolu, Ekin Kozal, Hannah Mönninghoff, Joachim Opitz

12.30-12.45

Multiproxy-, multiscale-approach for the identification of the pottery production technologies in the North Caucasus (Russia) in the Bronze/Iron Age
Ki Suk Park, Ralf Milke, Ilias Efthimiopoulos, Erik Rybacki, Ulrich Schade, Ljiljana Puskar, Regine Ricarda Pausewein, Sabine Reinhold

12.45-13.00

Tradition and Adaptation: The Potting Technology of Middle Helladic Archaia Pheneos
Clare Burke, Micheala Zavadil

13.00-13.15

Archaeometric study of Late Classic to Roman ceramics from Northern Greece-Contribution to Archaeomagnetism
Despoina Kontopoulou, Yuri Santos, Elina Aidona, Lambrini Papadopoulou, Niki Saridaki, Christina Rathossi, Christos Serletis

Session 03

Production centres and raw material studies

Chair: Lara Maritan

13.15-13.30	Archaeological and petrographic examination of the transformation of pottery production in 5-6th century Pannonia (Western Hungary) Katalin Bajnok, György Szakmány
13.30-14.30	Lunch
14.30-14.45	Studying the decoration techniques of the so-called “Port Saint-Symeon Ware” as a witness of interactions between populations in medieval north-eastern Mediterranean Jacques Burlot, Yona Waksman
14.45-15.00	Geochemical and petrographic insights into the pottery production during the Chalcolithic South-Central Iran Takehiro Miki
15.00-15.15	Elemental Distribution and Raman Spectrum Analysis of Raw Material Characteristics of Ancient White Pottery Xiaoke Lu
15.15-15.30	Nought Point Two Per Cent Titanium Dioxide: A Key to Song Ceramics Nigel Wood
15.30-15.45	Geochemical Warfare: Exploring Elemental Patterning within Emperor Qin Shihuang’s Terracotta Army, China Patrick Quinn, Yang Ying, Xia Yin, Detlef Wilke, Shangxin Zhang, Xiuzhen Li

15.45-16.00	The patterns and constraints in the production of Capacha pottery: geochemical and petrographic characterization of a Mesoamerican Formative ceramic assemblage Carlos Salgado-Ceballos
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16.00-16.30

Awards, next venue and closing

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LIST OF ORAL ABSTRACTS

Monday 16 Sep.

Provenance and networks

Chemical Analysis of Middle Bronze Age pottery complex from the site of Grotte di Marineo - Sicily (Italy)

Giuseppe Politi **1**, Anna Maria Gueli **1**, Orazio Palio **2**, Maria Turco **3**, Stefania Pasquale **1**, Giuseppe Stella **1**, Quentin Lemasson **4**, Claire Pacheco **4**, Laurent Pichon **4**, Brice Moignard

1 Dipartimento di Fisica e Astronomia "Ettore Majorana" UNICT e Sezione INFN-CT

2 Dipartimento di Scienze della Formazione - UNICT

3 Soprintendenza per i Beni Culturali ed Ambientali di Catania

4 Centre de Recherche et Restauration des Musées de France Paris

Ceramic, thanks to its resistance to ageing and to its copious production in almost any historic period, is one of the most important source of information about the prehistoric sites. In addition to the study of typology and style of artifact it is fundamental to obtain data from archaeometric study, concerning clay and finite product compositions, inclusions and trace elements, providing indication on the origin, the realization techniques and their evolution with time. The study of the important prehistoric pottery complex from the site of Grotte di Marineo, located on the northern slope of Marineo Mount, in the municipality of Licodia Eubea (Catania), offers the possibility to add new significant data in this field. The site, consisting of four natural caves, have been studied in the past years and the pottery found testified a continuous occupation from the Neolithic to the 6th century BC, with a gap just in the Late Bronze Age. The study has been focused on different ceramic class, with different chronology and utilization type, with shards coming from different stratigraphic units, in order to perform diachronic and synchronic comparison. The chemical composition of pottery shards has been analyzed with the external beam set-up of NewAGLAE at Centre de Recherche et Restauration des Musées de France, where the non-invasive techniques of Particle Induced X and Gamma Ray Emission have been used in order to obtain the major and minor components, with very low detection limits and small uncertainties. The results of these chemical investigations will be presented, providing important indications about the ceramic production technology in that area and its evolution in different periods.

Middle Bronze Age cult hypogea of Trinitapoli (FG, ITALY): pottery as a proxy for social interaction in the Tavoliere

Italo M. Muntoni 1, Rachele Modesto 2, Giacomo Eramo 3

1 Soprintendenza Archeologia, Belle Arti e Paesaggio per le Province di BAT e FG
2 Dottoranda di Ricerca, Dipartimento di Scienze dell'Antichità. Sapienza Università di Roma
3 Dipartimento di Scienze Geoambientali, Università di Bari Aldo Moro

This paper focuses on archaeometric analysis of ceramic materials from three hypogea (Fermatreccia, Guardiano and Structure 5) in Trinitapoli (FG, Southern Italy) on the Apulia Tavoliere plain near the Ofanto river and the Adriatic coast. Although underground structures, mostly used as tombs, had a long tradition in South-Eastern Italy, a specific phenomenon developed between the 18th and the 17th centuries BCE with the construction of a number of hypogea intended for cult purposes. Beginning in the 15th century BCE some of these were closed and never reused again, as is the case of the Guardiano hypogeum and Structure 5, while others were turned into collective tombs –such as the Fermatreccia hypogeum– and remained in use until the 13th century BCE. There is but this single group of hypogea on the Tavoliere. No settlements have, to date, been identified in the same area. This suggests that several settlements, including non-local ones, were using these hypogea. Ceramics deposited as part of cult activity and/or for funerary purposes can be used as a proxy for measuring the social catchment area of the cult hypogea. A total of 93 potsherds (Fermatreccia n = 48; Guardiano n = 35; Structure 5 n = 10) were analyzed by polarized optical microscopy in thin section (POM), X-ray powder diffraction (XRPD) and X-ray fluorescence (XRF). The sample selection was made after a macroscopic and morphometric analysis of the 415 potsherds for which the form of the pots had been previously determined. Thirty-three fabrics were identified, organized into five classes according to their main non-plastic inclusions (G* = grog; Q* = quartz; V* = volcanics; Ka* = carbonate aggregates; Px* = pyroxenes). Most of the fabrics show a carbonate-rich matrix and the presence of primary organic matter. The petrofacies recognized in the potsherds point to four different depositional environments during the Bronze Age of the Tavoliere plain: 1) alluvial plain; 2) alluvial-transitional plain; 3) northern Salpi lagoon; 4) southern Salpi lagoon. This demonstrates a cult use of the hypogea (which are located in the southern Salpi lagoon area) by peoples not only from the local area, but also from settlements further (but not too far) away. Long-distance interaction/use (i.e. Apennine, Gargano, Murge) can be excluded. A strictly local pottery production is inferred, although no settlements have so far been identified in the southern Salpi lagoon area. As for ceramic technology, most of the samples show medium to low sintering and maximum firing temperatures between 600 and 850 °C.

Tracing the Provenance of Red Lustrous Wheel-Made Ware (RLW): Petrographic, Geochemical and Sr-Nd Isotope Analysis

Mustafa Kibaroglu 1, Ekin Kozal 2, Andreas Klügel 3, Gerald Hartmann 4, Patrick Monien 3

1 Institute for Pre- and Protohistory and Medieval Archaeology, Eberhard-Karls University of Tübingen, Germany
2 Institute of Archaeology, Çanakkale Onsekiz Mart University, Çanakkale, Turkey
3 Department of Geosciences, University of Bremen, Germany
4 GZG-Geochemie, Georg-August-University Göttingen, Germany

Red Lustrous Wheel-made Ware (RLW) is a distinctive Late Bronze Age ware, distributed in a vast area in the Eastern Mediterranean including Anatolia, Cyprus, Egypt, and the Levant. Compositional similarity of RLW from various sites within the distribution area attested in previous studies, led to the assumption that RLW was produced from a single clay source in a certain region or production center. North Cyprus has generally accepted the most possible production place of this ware. However, the latest discoveries from Anatolia suggests that this ware must have been produced in Rough Cilicia in southern Anatolia. This study examines both theses by focusing on the geological sources of the raw material of RLW. To this end, extensive clay samples from north and southwest Cyprus, south Anatolia including Göksu river valley, central Anatolia, as well as Ceyhan Plain in Cilicia were analyzed using petrographic, elemental and Sr-Nd isotope methods. Archaeometric results support the archaeological propose that the RLW must have been produced in southern Anatolia.

Wine Roman amphorae from Cap Béar 3 shipwreck (Port Vendres). Assessing the beginning of the maritime trade between Hispania Citerior (NE Spain) and Gallia Narbonensis (S France)

Verónica Martínez Ferreras 1, Corinne Sanchez 2, Michel Salvat 3, Marie-Pierre Jézégou 4, Inga Sánchez Peris 5

1 ERAAUB, Universitat de Barcelona
2 Labex Archimede, Centre National de la Recherche Scientifique (CNRS) UMR 5140
3 Musée de Port-Vendres
4 Département de Recherches Archéologiques Subaquatiques et Sous-marines (DRASSM), Ministère de la Culture
5 Independent researcher

The Cap Béar 3 shipwreck (Oriental Pyrenees, SW France) is characterised by a particular heterogeneous cargo of wine Roman amphorae —Dressel 1B, Tarrakonense 1, Pascual 1 and Dressel 12— and an assemblage of covers, dated to mid-1st century BC. According to the archaeological data, most of the amphora types were produced in NE Spain while the Dressel 12 amphorae are attributed to S Spain. It is therefore considered the earliest evidence found so far of the maritime trade between NE Hispania Citerior and Gallia Narbonensis. In order to identify the provenance of the cargo, an archaeometric study was carried out on 59 amphorae, one cover and six ceramics (pots and tableware) belonging to the crew. The chemical and the mineralogical analysis were investigated through X-ray fluorescence (WD-XRF) and X-ray diffraction (XRD) respectively, while the petrographic composition was examined through thin section optical microscopy. As part of an ongoing research project focused on the production and trade of wine amphorae from NE Spain, the results were compared with the ERAAUB’s analytical database. It includes archaeometric data on 1400 amphorae from 27 production centres and from several consumption centres and shipwrecks. Thus, the study reveals that all the amphorae from the shipwreck (included the Dressel 12) were produced in several workshops located at the central Catalan coast (ancient Laietan region). Indeed, the archaeometric characterisation of the cargo provides valuable information of the production and trade dynamics developed in the late Roman Republican period between the western-most Mediterranean provinces.

Provenance studies of amphora production and trade patterns along the Eastern Adriatic coast in Pre-Roman period

Maja Mise 1, Patrick Quinn 2

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The Marie-Curie funded research project Economy of Pre-Roman Adriatic Communities: amphora production and trade patterns in a changing world (EPRAC) aims to shed light on the economy of the Adriatic region during the Pre-Roman period via the distribution of amphorae and trade in wine and olive oil that they contain. It focuses on the under-studied period between the establishments of Greek settlements in the 4th c. BC until the consolidation of Roman power toward the end of the last millennium BC. Thin section petrography and bulk geochemistry will be used to compositionally characterise the amphorae products of two important Greek workshops, Issa and Pharos, on the Dalmatian Islands, southern Croatia. These reference groups will then be compared to amphorae from nine consumption sites, seven indigenous settlements and two sanctuaries visited by the Greek sailor and local communities, as well with amphorae from four shipwrecks locate don’t he possible trade routes along the Eastern Adriatic coast. These comparisons will facilitate to track amphorae circulation patterns from the two workshops along the eastern Adriatic coastline. Comparison with published studies from elsewhere in the Mediterranean basin will be used to examine the nature of trade and interaction between indigenous communities on both Adriatic coasts and further afar. This presentation will summarise the on-going project and share initial compositional results and archaeological findings.

Changes in Production Traditions of Cooking Pots during the Iron Age in the Southern Levant

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Generally cooking wares in antiquity illustrate specific clay selection and potter's technology in their production tradition. In the southern Levant cooking pots were often made of calcareous-tempered fabrics during the Neolithic, Chalcolithic and Bronze Ages. In these cases crushed calcite, shell or limestone was added to the paste by the potters. In some stage during the late Iron Age (ca. 1000-586 BCE) there seems to be a change in this tradition, and more cooking pots are made from a non-calcareous clay rich with or tempered by quartz. During this period smaller and thinner cooking pots are also evidenced, as well as the usage of fast wheel and the production of wheel-thrown vessels. In the Hellenistic and Roman period there seems to be already a clear shift to quartz-rich cooking ware. This study will examine this issue with the region of Judah as a test-case. In this region Iron Age II cooking pots were usually made from non-calcareous clay (mostly derived from terra rossa soil) and were tempered with calcareous sand and/or quartz. The potters during this period seem to avoid the use of 'Moza clay' with dolomite sand, a clay common in the Judean hills, for the production of cooking pots. The data will be examined and discussed in the light of previous and current petrographic analysis carried on cooking pots in various sites of Judah as Jerusalem, Moza, Nasbeh, Marjameh, Beer-Sheba, Malhata, Eton, Socoh and Qeiyafa.

Spatial Patterns of the ceramic production in Colonia Augusta Achaica Patrensis

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The connectivity between ceramic artefacts and human presence has been studied in many areas of the Roman world. Roman provinces did not exist as entities, but as a part of a complex system involving their urban and rural landscape, communications and networks. Following this concept, our research is focused on the existence of ceramic workshops in Patras, the major city and harbor of the province of Achaia (Provincia Achaëa), Greece, since its establishment as a Roman colony of the emperor Augustus, underlining its role as a production center in the trading networks. We have collected data for every excavation characterized by the existence of at least one or more ceramic kilns. Our datasets consist of plans, drawings, photographic archive, diaries and published descriptions of almost 40 excavations comprising 50 kilns. Furthermore, we supplemented the cataloging of kilns, alongside with geodata of the primary locations, developing a digital information system for intra-site archaeological documentation. Whenever the workshops were operating nearby important distribution hubs and transport networks, the spanning of the road system was the next important element to take into account. Thus, a new dataset was created with information for Patras' road network. Under this framework, our approach has employed, the technology of Geographic Information Systems and takes advantage of their potentiality towards the spatial representation and the visual exploration of archaeological data. The visualization of both road network and ceramic kilns, created a new approach of the reviewing datasets, within the city's urban space. The degree of clustering among each kiln construction and their spatial organization in the urban structure is of crucial factor in defining their domestic or industrial use and in characterizing the ceramic products as local or imports.

Multidisciplinary characterisation of African amphorae and Red Slip Ware from the Roman city of Thaenae (Tunisia)

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Since the 2000s, research on Roman African ceramics has been extensively developed thanks to the integrated archaeological and archaeometric characterisation of several pottery workshops in North Africa. In the continuity of this topic a multidisciplinary study on the ceramics found at the site of Thaenae, located 12 km south of Sfax, along the coast of central Tunisia, is in progress. We will present here the results of the typological, petrographic and geochemical (by portable XRF) analyses on the local production of amphorae and the imports of African Red Slip Wares from both northern and central inland Tunisia. Moreover, the combination of these three approaches aims at creating a geochemical reference database on Thaenae's ceramics and to establish an effective analytical protocol for portable XRF measurements on North African ceramics. Preliminary portable XRF analyses of African Red Slip Wares productions already revealed several chemical markers - in addition to the petrographic ones - allowing the inland productions to be distinguished from the well-known workshops of central and northern Tunisia. That reference database will also be used for the analysis of African pottery of consumer sites such as Portus (Rome) and the Agora (Athens), in order to identify the imports from Thaenae as well as inland Tunisia, of which Thaenae could be the exporting port. More generally, this study will be able to assess the importance of Thaenae in the economy of southern Byzacena during Antiquity but also its role in the exchange networks of the Mediterranean basin.

The production of lead glazed tablewares in late medieval Italy and their exportation to Latin Greece: New considerations on 14th-century contexts from Corinth, Peloponnese

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The decoration of lead-rich glazed pottery following eastern Mediterranean styles in late medieval Italy is a phenomenon that has received much scholarly attention, with the works of Claudio Capelli on the Graffita Arcaica Tirrenica from Liguria, and the works of Lorenzo Lazzarini on the Spirale Cerciò from the Veneto. Nevertheless, the extent and modalities of this phenomenon require further examination. At the Frankish Area at Corinth, Peloponnese, several pottery deposits are dated to the Florentine domination of the city in the mid- to late 14th century. They are informative of a late, yet under-documented, phase of development of an artistic koine throughout the Mediterranean that had begun in the 12th century. The petrographic analysis of 97 glazed tablewares revealed that at least 45 items were imported from northern Italy. Ligurian imports include a dozen bowls and dishes in the Graffita Arcaica Tirrenica style, along with Glossy Orange Wares, Zeuxippus Ware Class II and Fine Sgraffito Wares. Aside from Rouletted and Veneto wares, Venetian imports include Zeuxippus Ware Class I, Glossy Orange Wares and Spatter-Painted Wares. Glazed White Ware II was imported at Corinth from the Adriatic basin and the Marches region. The stylistic diversity of this set of imports suggests some equally diversified tastes and demands in Italy and Italian territories of the Aegean, and the ability to satisfy these demands through a delocalized craftsmanship. We explore technical aspects of the production of these Italian products and we compare them to their eastern Mediterranean prototypes: we focus on pottery profile and proportions, firing regimes (petrography, XRD), slipping materials (petrography, SEM-EDS), glazing techniques (SEM-EDS, Raman spectrometry, LA-ICP-MS). Special attention is brought to patterns of knowledge sharing between craftsmen in Italy and the East; more particularly, we investigate the possibility of craftsmen mobility as a catalyst for this artistic koine.

Under the estuary of Aveiro: a 15th century shipwreck and its cargo of ceramics

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Aveiro, a city located in northern Portugal and that lies next to the Atlantic Ocean, has a long potting tradition. Indeed, during the 15th-17th centuries, this region played an important role in the maritime trade between the north of Europe and the Iberian Peninsula along with the colonial settlements overseas. Historical records reflect regular trade contacts between ship-owners and masters of Aveiro with English, Irish, Flemish, Galician and Basque entrepreneurs. During the archaeological interventions carried out between 1996 and 1999 in the estuary of Aveiro, archaeologists found a shipwreck (RAVA) dated by radiocarbon in the mid-15th-century carrying a large amount of ceramics as cargo. Such set of pottery, consistent with late medieval and modern era chronologies, enabled the establishment of a typology made out by 18 different types: tableware (e.g. bowls and jars), kitchen utensils (e.g. pots and pans), storage or liquid transport (e.g. pitchers), for personal hygiene (e.g. chamber pots) and moneyboxes, among others. With a view to characterize and to assess the provenance of local or regional origin of this post-medieval pottery assemblage recovered in the shipwreck, an archaeometrical approach of 16 unglazed ceramics showing red or black pastes has been performed. In this way, chemical, mineralogical and microstructural analysis by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), X-Ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) analytical techniques have been carried out. Moreover, the provenance of the shipwreck ceramics has been further assessed by comparing against the main reference groups from Portugal and Spain productions, as well as local Aveiro productions.

Did the student become the master? The development of the glaze technology in Cyprus during the 13th to 17th centuries AD

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Although the local glazed ware production in Cyprus did not begin until the 13th century AD, as represented by the Paphos-Lemba production, glazed wares continued to be produced until the modern times; constituting a crucial aspect of the Cypriot cultural heritage. However, the Paphos-Lemba production was a short-lived one and was soon replaced by other productions in the Famagusta, Lapithos, and Nicosia region, which we know very little about the technologies and organisations of these later productions. Did they continue using the same technology as the early production, indicating the occurrence of direct learning from the Paphos-Lemba craftsmen? Or did the later productions have different technologies, which might reflect the influence from other well-established traditions, since there was a marked increase in the movement of and contact with people from places such as Latin Syria and Venice. This paper seeks to explore the range of technologies characteristic of these later productions, in terms of the glaze composition, the method of glaze application, the method of slip preparation, and the mode of decoration. SEM-EDS and thin-section petrography were used to analyse various glazed ceramic assemblages representative of the said productions across Cyprus. The resultant data will be first compared with the early local glaze technology, and then with the published data on contemporaneous glaze technology in the Mediterranean. This will allow us to highlight the changes and continuities in glaze technology within the local context, and their link to the broader technological trends and socio-political developments; and more importantly, to delineate the mechanisms and socio-cultural processes that were responsible for the transfer of technologies that would have contributed to the maturity of Cypriot glaze production.

From Pastes to Glazes: Assessing Provenance and Technology of Islamic Glazed Vessels from Ancient Termez (Southern Uzbekistan)

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This paper presents the archaeometric characterisation of Islamic glazed wares from ancient Termez (southern Uzbekistan). According to archaeological data and radiocarbon analyses, at least from the 8th/9th century CE glazed and unglazed wares were manufactured at Termez in specialised pottery workshops located in the suburbs (rabad) and outside the walls; in the early 13th century, possibly after the Mongols’ invasion, pottery production moved to the previous residential area (shahrstan). A recent archaeometric study allowed characterising the local glazed and unglazed products and identifying the imports. Herein, we present the specific research work carried out on 36 glazed vessels dated between the 8th/9th and the 16th/17th centuries CE. They comprise slip-painted, underglaze painted, splashed sgraffiato, and monochrome wares, as well as opaque white glazed vessels, including lustre-painted specimens. Pastes and glazes have been analysed through X-ray fluorescence (WD-XRF), X-ray diffraction (XRD), thin section optical microscopy and scanning electron microscopy (SEM-EDS). Crystalline phases inside glazes were investigated by micro-XRD. The results allow suggesting the provenance of the vessels; in particular, the production areas of some imports have been proposed. They also provide valuable information on technology (the procurement and processing of raw materials, forming, surface treatments, glaze recipes, and firing). Moreover, the study reveals that glazed pottery production at Termez underwent changes in technology and fashion during the Islamic period. Indeed, until the 12th century, potters produced slip-painted, underglaze painted, monochrome and splashed sgraffiato items using clayey slips and lead-based glazes. Differently, slips rich in quartz grains and alkali glazes characterised the later productions, consisting of turquoise monochrome vessels and underglaze painted wares, which circulated from the late 12th-13th centuries onwards.

Early Celadon in North China: Compositional Characteristics and Technological Transmission

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The production of Chinese celadon can be traced back to the Bronze Age, when the so-called proto-porcelain or proto-celadon was first manufactured in the lower Yangtze river valley in the 17th century BC. Celadon making then gradually spread throughout a vast area in South China, but was not produced in the North until the second half of the 6th century AD. Very soon afterwards, the first white porcelain was produced in the North. Aiming at a better understanding of early northern celadon, the present research is focused on the manufacturing technologies of the earliest northern celadon wares. Chemical and mineralogical composition of the body and the glaze, glazing method, firing temperature and atmosphere were studied on the basis of the analysis by optical microscope, scanning electronic microscope with energy-dispersive X-ray spectrometer(SEM-EDS) and X-ray diffraction(XRD), which provide insights into the pathway by which the southern celadon technology was transferred into the north, the formation of the features of the northern celadon, the internal diversity and interaction among the northern production centres, and its technical relationship with the earliest white porcelain.

Early domestic production of lead-glazed earthenware in Japan: Analytical studies of excavated ceramics from the 7th and 8th centuries

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This study incorporates the results of provenance studies of raw materials, paying special attention to lead isotope ratios in glazes and XRF of body clay. Japanese archaeological lead-glazed ceramics from 7th and 8th century include both imported and domestic examples. In this report I have compared their raw materials and surface finishing methods to deduce their technical genealogy. Past research gives us some clues as to the some technological differences between Chinese and Japanese lead-glazed ware. The Chinese tricolor ware was fired to higher temperatures and had lower iron content than Japanese tricolor ware. Japanese earthenware with painted patterns using yellow and green glazes on white bodies was influenced by Chinese tricolor ware, but it used Japanese domestic firing methods in addition to imported technology. Before the production of domestic tricolor ware began, Japanese kilns were producing monochrome glazed ware. In past research, I carried out lead isotope analysis and classified examples of excavated monochrome ware from the 7th century. As a result, I reported the probability that imported monochrome ceramics were being imported not from China but instead from the Korean Peninsula. In this paper, I consider the results of this previous research in conjunction with the makeup of the clay bodies of these wares. From this, I am able to deduct that monochrome were used not only on imported wares from the Korean Peninsula but also on Japanese domestically produced tiles and Sueki ware. To test my hypothesis that domestic Japanese tiles and Sueki ware were the origin of domestic tricolor ware, I examined and noted the similarities and differences between those wares in order to characterize their production techniques. There are various complex factors involved, but my conclusion is that the biggest influence on Japanese tricolor production was technology learned from emigrants from the Korean Peninsula.

Ceramic Production Technologies and Ancient Interaction Networks of Multi Ethnic Communities at Multi-Component sites of the Átures Rapids, Middle Orinoco, Venezuela

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Early written sources on the inhabitants of the Middle Orinoco singled out the Átures Rapids as a key trading centre at which people from the Guyana, Amazon and the Western plains met to exchange goods and ideas between the 16th and 18th century. The pre-colonial indigenous occupation of this area remains poorly known, particularly in terms of the peopling of the rapids and the details of the exchange systems that existed at this time. Previous studies of ceramic materials from surface collection and test pits on Cotúa island and surrounding areas described the pottery in terms of form and style, following a cultural historic approach, and tackling mainly chronological questions. As part of an on-going PhD project at University College London, pottery sherds recovered from three newly excavated sites (Culebra, cal. 996BC-AD1155; Rabo Cochino, cal. AD130-1295; Picure cal. AD392-1490) have been analysed in detail using macro trace analysis, thin section petrography and portable X-ray diffraction. This has revealed a varied range of co-occurring paste recipes that use several different inorganic and organic ingredients, follow distinct production technologies and display different vessel forms. The occurrence of these traditions at the three sites and their stratigraphic distribution has been used to shed light on the various pre-colonial occupations and interaction processes of the Átures Rapids. The emerging picture challenges the idea of a single traditionally defined ‘ceramic culture’ for the region and suggest instead a more complex situation of multi ethnic communities, engaging in complex trading and interaction activities at this important locus on the Middle Orinoco river.

Evaluation of nano-lime dispersions as swelling inhibitors for the protection of clay-based building materials

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Clay-based building materials are frequently found in adobe architecture in many archaeological and cultural heritage sites in the Mediterranean basin. One of the main problems faced for the preservation of those structures is related to the swelling phenomenon of clay minerals and the subsequent effect on the degradation of the structure, especially in variable climate conditions. This correlation was evident in the cases of the physicochemical characterization of the adobe bricks in the pre-historic archaeological sites of Toumba (Thessaloniki) and Dispilio (Kastoria) in Greece. Aiming to contribute to the conservation of earthen architecture and mitigate the swelling, this work studies the effectiveness of different conservation treatments based on calcium hydroxide materials. The treatments incorporate two different categories: saturated solution of calcium hydroxide (traditional limewater) and different types of nanophase lime synthesized at the laboratory. Specifically, this paper studies the effect of the dispersion medium (water and mixed polar solvents) and the morphological characteristics of calcium hydroxide (shape, particles size) on the reactivity and stabilization of the microstructure of clays. The evaluation of the consolidation treatments was focused on the examination of the potential modification of microstructural and physical characteristics of laboratory synthesized adobe briquettes with different swelling capacities, induced by different percentages of montmorillonite (1, 5 and 15 % w/w). The mineralogical and chemical characterization were carried out with X-ray Diffraction (XRD) and Fourier-Transform Infrared spectroscopy (FTIR) analyses. Scanning Electron Microscopy (SEM), and standard laboratory EN tests provided insights on the swelling behaviour of clay mixtures. The interpretation of the results indicated the beneficial role of laboratory prepared nano-lime dispersions when they are used as swelling inhibitors, causing significant reduction of volume changes and increasing the durability of adobe building materials against water. [Acknowledgements This research is co-financed by Greece and the European Union (European Social Fund-ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project “Strengthening Human Resources Research Potential via Doctorate Research” (MIS-5000432), implemented by the State Scholarships Foundation (IKY)]

The manufacture and distribution of tiles in Classical Chalkidike: a geochemical and petrographic study of the ceramic building economy

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This paper will present results of a geochemical and petrographic analysis of tiles and geological samples from the region of Chalkidike in Northern Greece. The results are part of a PhD research project that investigates the economic cycle of manufacture, distribution and consumption of tiles in Chalkidike. The majority of the dataset for this study consists of tiles recovered via excavations and surface survey in and around the settlement of Olynthos. While much progress has been made in reconstructing domestic life at this settlement, there are many unanswered questions about the ceramic economy, as no ceramic kiln or workshop from the classical period has been found. Especially with the rapid, large-scale construction of the new residential area on the North Hill due to a migration movement, Olynthos forms an ideal case to study the economy of this ceramic building material. Interestingly, according to ancient written sources roof tiling did not even necessarily belong to a single real estate and might move with its inhabitants. One of the main objectives of this paper is to investigate the possible provenance of the raw materials, and issues related to clay preparation, processing and firing. Additionally, other ceramic wares from Olynthos are incorporated and some tiles from the settlements of Akanthos and Stageira to provide a broader and regional perspective. The results will be compared to geological clay samples from the region. One of the questions that I will address is whether the manufacture of tiles was locally organised or whether the ceramic tile workshops performed on a larger, more regional scale. In this study, geochemical analysis with a portable ED XRF device and thin section petrography are used to explore these aspects of the production and distribution of tiles in this region.

Ceramic Pipes of the Roman Aqueduct from Raiano Village (L'Aquila, Italy): A technological Study

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Roman aqueducts are an example in which material knowledge and engineering skills melt together to create extraordinary architectural works that have been survived in the centuries. Even if Roman aqueducts reflect the engineering knowledges of the past, very few archaeometric works took into account these artworks in Europe or in Italy. Considering this gap in the scientific studies, this work is focused on the study of ceramic pipes of the final part of the Uccole Roman aqueduct built in the 1st century AD by the Romans between the Subequana Valley and the Sulmona Plain (Abruzzo, Italy). A multi-analytical approach consisting in optical microscopy, scanning electron microscopy and X-ray powder diffraction was applied to investigate the technological background and to reconstruct the provenance of the raw materials involved in the production. Petrographic and mineralogical results suggest the presence of one petrographic fabric produced using an illitic clay with fine inclusions of quartz, K-feldspar and micas and a coarse fraction mainly composed by fragments of volcanic, sedimentary calcareous and siliceous rocks. The analysis of the grain size distribution and the shape of inclusions suggest a careful selection of the material with the addition by manufacturers of the coarse grain inclusions to create a strong material. The mineralogical assemblage indicates a firing temperature in the range 700–800 °C, in oxidizing conditions. The presence of fragments of basic volcanic rocks as inclusions suggests the supply of the raw materials from a local pyroclastic deposit. These results underline that the use of volcanic ashes in architectural works was not limited to Rome and during the conquest of Abruzzi territories by the Romans, the local populations were influenced by their technological skills.

Technological study of early 20th century mud bricks

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This study aims to evaluate the physical, chemical and mechanical properties of mud bricks used as building material, aiming to better understand the technological parameters that were taken into account in adobe structures in cultural heritage structures. The in-depth understanding of the production technologies and the choice of raw materials is of great importance both in conservation related applications, as well as to our overall perception of material culture. Three different types of mud bricks were examined and the results were compared and discussed in terms of chemical and microstructural properties, as well as preservation condition. Well preserved functional bricks, old restoration (60-80's) bricks and contemporary bricks form the experimental setup of this study. The samples were characterized following a multidisciplinary approach, combining macroscopic observation with petrographic examination, mineralogical analysis (XRD) and microstructural and chemical analysis (SEM-EDS). The compressive strength of all mud bricks was also determined. The results from the laboratory campaign were supplemented with in-situ non-destructive tests, regarding water penetration rates, presence of salts and moisture content. It was found that all three brick types exhibit very low compressive strength values, exhibiting continuous plastic deformation. Moreover, XRD patterns showed the mineralogical differences between the three types of bricks examined suggesting that the soil used for the restoration bricks originates from two different types of clay. It is shown that the preservation condition and the type of clay used in the three different cases affects the mechanical properties and the overall performance of the mud bricks.

The CLAYONRISK project: bricks manufacturing technologies to increase the built heritage resilience and to raise the common identities of peoples

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The Built Heritage is increasingly at risk mainly due to environmental changes and natural hazards. As traditional material, building bricks represent an eco-innovative solution for restoration purposes meaningfully linked with cultural identity of peoples. Framed on current ceramic industry challenges and risk assessment of cultural heritage strategies, CLAYONRISK aims to underline the technological and heritage value of building ceramics. The project entails an interdisciplinary approach to set up the influence of the manufacturing processes on bricks -ancient and new produced- to strength the resilience of ancient structures, bringing together green-solutions and common cultural values. In CLAYONRISK, the multidisciplinary study of building bricks is launched as Disaster Risk Reduction (DRR) preventive measure, as bricks resistance over time is tackled from the manufacturing process. Moreover, the multisectorial cooperation is also addressed, as the interaction between academic and industrial research is explored. The multianalytical study pursuit by CLAYONRISK is mainly based on archaeometric methodologies, where color measurements by means of Fibre Optics Reflectance Spectroscopy (FORS) and compositional/textural analysis trough X-ray fluorescence (XRF), powder X-ray diffraction (PXRD), polarized optical microscopy (POM), field emission scanning electron with EDS microanalysis microscopy (FESEM-EDS), Nuclear Magnetic Resonance (RMN) or Raman Mössbauer spectroscopies are performed. Likewise, bricks resistance over time is assessed by artificial ageing tests (ASTM D 5313, EN 14066:2013, EN 12371:2010) and physical (hydric and mechanical) parameters determination, such porosity and pore size distribution by means of Mercury Intrusion Porosimetry (MIP), the total (ΔM) and relative (Δm) anisotropies (EN 1926:2007) or the pull strength (EN 12390-6:2001) and flexural strength (EN 12372:2007). The results achieved by CLAYONRISK, carried out under a MSCA European Fellowship, will open a new line of research, where the assessment of manufacturing parameters -mainly clay composition and firing temperatures- on bricks physical behavior, the environmental improvements and energy saving at current brick production and the cultural values of peoples are jointly addressed.

Tuesday 17 Sep.

Technical ceramics and vessel function

Shared technological milieus: defining the borders between wheel-made and hand-made pottery production in Early Helladic Argolid

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By the late 3rd millennium BC, the Helladic communities experienced one major technological change: the sudden appearance of the potter's wheel in the northern Peloponnese, which inaugurated new technological traditions founded on craft knowledge of higher technical specialization. Despite its techno-functional advantages, the new tool was not widely adopted and remained a rather marginal potting practice on the side of the dominant hand-made production. To understand the coexistence of these different craft behaviors within the same technological milieus, we advocate an anthropological interpretation of pottery assemblages that conceives technologies as part of an entire social system of knowledge, materials, skills, and ideas, which transforms raw materials into final products. For the reconstruction of the chaînes opératoires behind production, we have elaborated and applied an innovative interdisciplinary approach, which is based on the combination of different analytical tools, usually considered and applied separately in ceramic studies: (a) macroscopic inspection of pots for identifying of forming and finishing techniques; (b) industrial radiography for insight into clay-microstructures and detection of invisible gestural movements involved in primary forming operations; (c) ceramic petrology for tracing technological choices associated with clay sources, fabric recipes and firing regimes; (d) elemental analysis of ceramic bodies for further exploring provenance and technological landscapes. This combined methodology enables pots description as the outcome of synergies of different potting actions and thus allows for tracing aspects of embedded traditions. In this study, we will explore the potential of this manifold analysis towards the understanding of the wheel integration process. To this end, the technological choices involved in both hand-made and wheel-made pots of the Early Helladic III (c. 2200-2000) found in two settlements in Argolis, Lerna and Tiryns, were compared. The aim is to shed light on the complex modalities and the underlying cultural dynamics behind the wheel's appropriation and dissemination into the local technological, and hence, social milieu.

An Interpretation of thermal analyses on some Glass fragments from the city Istakhr to determination about the heating temperature construction of ancient glass

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The city Istakhr is one of the most important Iranian archaeological sites in Fars province, located 5 km north of Persepolis. This area was a great and importance periphery during the Sassanian Empire. The architectural remnants (from 224 to 226 AD), came to the light in recently excavations and show the glory of the city during this time. Through the excavation of the year 2015, numerous glass pieces have obtained from this area. These glass pieces were all dated back to 5th century AD and have been used as a container, bottles or censers which have been especially important in this regard. These glass fragments were analyzed in order to determine the melting temperature followed by tracking the technology of glass making in that period. Based on DSC/TG thermal analyses, the temperature of making this glassware was determined between 980-1190°C. Micro-structure studies of glass fragments shows that they are assigned as the high-temperature glasses, which clarifying the skill and technology of artisans in controlling the furnace heat and know-how about the raw-mix in glass industry.

Reading surfaces: on the determination and properties of surface treatments. Towards a better understanding of clay vases function

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Pottery has been widely studied from a typological and technological point of view. Although they bring important knowledge about past behaviours, use wear analysis are still underdeveloped compared to other materials such as lithic or bone tools. This paper aims to identify the function of clay vases through the lens of thermal and mechanical use wear analysis. Early works in that field have thus revealed the importance of technical choices regarding the strength and tightness of surface treatments (Skibo 1997; Skibo and Schiffer 1987; Muller et al. 2014; Bronitsky and Hamer 1987; Tite et al. 2001 etc). However, there are yet no available repositories on the subject. Our goal is to present a work in progress dealing with a long-term experimental program on surface properties. Experiments were conducted using different tools, different kind of surface treatments, different slips and, finally, different times of execution and gestures. Beyond sensory perceptions, measurements were achieved at both macro- and microscopical scales. By doing so, we were able to put to test our visual and touching classifications by comparing them with archaeometric measurements. Some preliminary comparisons were made with the French Neolithic cooking pots and Aegean Bronze Age clay lamps, thus offering a wide panel of techniques and wears. On an archaeological perspective, this work contributes to the definition of the concepts of “intended function” (Skibo 2013) and potters’ skills.

Petrographical and geochemical characterizations of the late antiquity unguentarium from the archaeological site of Tripolis, Denizli (southwestern Turkey)

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The results of the petrographic and geochemical analyses of unguentarium samples from the late antique period from the Tripolis (Denizli), was in the crossroads of the Phrygia, Caria and Lydia regions, are presented. In particular, optical microscopy, X-ray diffraction, X-Ray Fluorescence and SEM were used for the determination of the morphological, chemical and mineralogical characteristics of the unguentarium samples. The thin section and XRD analyses show that unguentarium samples composed of an amorphous matrix with various inclusions and/or voids and divided into three petrographic groups. Group 1 samples consist of abundant quartz, plagioclase, gehlenite, rarely calcite, clinopyroxene, mica (biotite and muscovite) and iron minerals. Group 2 samples have similar mineralogical compositions but they have only lesser quartz and further calcite than group 2. Group 3 samples have abundant void and rarely quartz, plagioclase, gehlenite. Petrographic differences between sample groups are supported with the chemical compositions. The presence of gehlenite mineral in the sample matrix indicated higher firing temperatures (approximately 900 or 1000°C). The coexistence of calcite and gehlenite can be practically interpreted as a secondary calcite, which has formed in samples as a result of post-burial deposition processes. The obtained results showed that illitic clays were used for production and the unguentariums were manufactured from local clays in Denizli region. Tripolis unguentarium samples were compared with the previous studies from the other archeological sites. Although Tripolis samples shared similarities in the geochemical compositions of raw clays and production technique from Hierapolis, Sagalassos and Laodikea, differences can be also recognized from Ephesus.

Tuesday 17 Sep.

Statistics and databases in ancient ceramic studies: papers in honour of Mike Baxter

Preserve, enrich, share, interconnect: ongoing developments of the Lyon CERAMO database

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Various analyses of archaeological artefacts have generated over the years in our laboratories large corpuses of archaeometric data. How to preserve, store, make these data accessible, as well as the attached samples collections? what are their specificities, which standards can we propose to model them? how can we ensure their sensible reuse? how can we interoperate and interconnect them to exploit their complementarity? which possibilities are brought by the new concepts, uses, IT and statistical tools recently developed, especially in the field of digital humanities? These issues are under study in Lyon laboratory, as well as in the working group “Databases and reference models” of the French archaeometry network CAI-RN. They are leading to ongoing developments of the Lyon CERAMO database, one of the richest database of chemical analyses of ceramics in Europe. It is presently re-modeled and enriched with 2D and 3D data as a research and educational tool in public access. These developments are the opportunity to test different paths in data mining and clustering analysis of complex archaeological and archaeometric data.

Shot from the Hip – Dealing with imprecise and incomplete data of pottery analyses with portable energy dispersive XRF

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Provenance studies of archaeological ceramics based on their elemental composition have a long tradition in archaeological science. Compositional differences, essentially related to the use of geochemically different raw material sources, allow for distinguishing different production sites. In order to reduce the effect of analytical uncertainties on the variation of the determined compositional patterns, commonly laboratory methods with high precision and accuracy are applied in ceramic provenance studies, such as neutron activation analysis (NAA) or wavelength-dispersive X-ray fluorescence spectrometry (WD-XRF). During the last 20 years, however, portable energy dispersive XRF (pEDXRF) was introduced in the study of archaeological materials. Handheld pEDXRF systems provide fast, inexpensive and non-invasive measurements of elemental compositions of a variety of materials, among others also ceramics. Particularly in the case of pottery analyses, however, several issues arise. The method is extremely surface sensitive, which has to be considered for measurements of slipped, painted or weathered surfaces. The determined element concentrations are commonly less precise and accurate than compositional data collected with laboratory measurements and also the suite of elements, which can be potentially be measured, is smaller. In the case of trace elements the concentrations are furthermore frequently below the lower limit of determination. Eventually, also the sample geometry affects the measurements as the systems are calibrated for measurements of plane surfaces in direct contact. All these issues impede the statistical evaluation of pEDXRF data following common approaches applied to compositional data collected by laboratory analyses, such as cluster analysis or principal component analysis. Nevertheless, obviously compositional patterns determined by pEDXRF still can be distinguished or grouped together, taking into account, however, changing element suites and singular deviating element concentrations. For this, alternative evaluation approaches are tested employing neural networks and fuzzy logic.

Multivariate ‘mixed-mode’ analyses for characterising archaeological ceramics using the cerUB package in R

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Several analytical techniques are potential data sources for characterizing archaeological ceramics. Each technique returns information that is significantly different, though partially overlapping. Unfortunately, it is not so common for studies to integrate the results of more than one analytical technique and, when they do, it is often through textual description and argument rather than statistics. As suggested by several authors in the past, including Mike Baxter, the lack of integration through quantitative methods is an obstacle for more informative data analyses, the comparability of datasets, and reproducibility. To help to overcome this problem, we defined four protocols for multivariate analysis of ceramics, each covering different types of input data. Protocols 1 and 2 guide, separately, the analysis of geochemical compositions (e.g., XRF) and petrographic observations through thin-section Optical Microscopy. Protocols 3 and 4 are two varieties of a hybrid or ‘mixed-mode’ approach that integrates the geochemical and petrographic data, returning a general picture of the diversity of materials. Acknowledging the diversity within the field, we propose these protocols not as fixed recipes, but as frameworks to perform and compare different analytical strategies. All four protocols were made available as a package in R (cerUB), which is free and open-source. This presentation will focus on demonstrating the four protocols, and explore their possibilities, using the open dataset included in the package (‘Wine Roman amphorae from Catalonia, NE Spain’). A more detailed demonstration can be found in our online tutorial (https://andros-spica.github.io/cerUB_tutorial/).

Tuesday 17 Sep.

Applied decorations

Gloss Chemistry and the Origins of the Corinthian Black Figure Technique

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This article presents the results of a study on the manufacturing process of Archaic Corinthian pottery, and the recipes employed by the potters in the preparation of suitable clays, paints and slips for the application of Black Figure decoration. The use of pXRF technology has allowed the analysis of 98 samples from the collection of the Archaeological Museum of Korinth that were not susceptible for destructive sampling, revealing a previously unknown change in the chemical composition of these vessels, which coincides with the development by Corinthian potters of the Black Figure style at the beginning of the Middle Protocorinthian I period (690-660 BCE). The results of this research indicate that the Black Figure technique was developed using a previously unknown recipe for the preparation of slip. This discovery sheds new light upon the diversity of local styles in Greece, and challenges two previous untested assumptions about the manufacture of Corinthian pottery: that the paste and the slip for the vessels decorated in Black Figure were made using the same clay (this assumption was based solely on tests on Athenian wares), and that the source of raw material for the Corinthian pottery industry could not have been the calcium-rich natural clay deposits that surround the settlement. This change in paint and gloss recipe required the use of new raw materials (rich in Fe and K), and necessitated a change in access and control of these scarce resources. Thus, I also consider how this change impacted the relationship between potters and their local community. Finally, this work shows the potential of a careful application of pXRF technologies for the analysis of highly decorated wares in museum collections for which other compositional techniques that require destructing sampling are not available.

Polychrome glazed ceramics in al-Andalus (9th-12th centuries): methods of production and materials

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The production of polychrome glazed ceramics started in al-Andalus (Muslim Iberian Peninsula) in the late Emiral period (late 9th-early 10th centuries). They were high-lead transparent glazes and the decoration –amber, green and brown colours- was applied overglaze. After that a new technology was developed with the introduction of tin for opacifying glazes, while the same way of applying colours was used. These first polychrome glazes covered a range of tableware (serving-dishes, cups and jars) and decorative patterns, while they were simple but varied, mainly traces and splashes (SALINAS & PRADELL 2018). During the 10th century, in the Caliphal period, decorations and themes were more complex (epigraphic, plants, zoomorphic and anthropomorphic), while a standardisation of shapes and colours took place in the Córdoba production centre, related to a centralisation policy under the Umayyad power. Eastern trends influenced in the adoption of some themes and colours, but not in shapes. After the collapse of the Umayyad Caliphate, it seems that the tin-opaque technique spread by the Muslim Iberia (Taifa Kingdoms). New peripheral specialised workshops emerged and produced distinctive polychrome tin-opaque tablewares. However, in the late 11th-12th centuries, ruling the Almoravid dynasty, polychrome opaque glazed ceramics experienced a decline, and it is not clear even if they disappeared. It was not until the Almohad period (late 12th-early 13th centuries) when there was a revival of the polychrome technique, but with technological and decorative changes, influenced by North Africa, such as the application of underglaze decoration, in addition to new decorations and shapes. Methods of production and materials used for colorants, pigments and glazes have been analysed by OM, SEM-EDX and $\times$ -XRD to understand changes and continuities in the production of polychrome glazed ceramics, from 9th to 13th centuries, and how rulers directly influenced in the evolution of this semi-luxury production. References Salinas, E., Pradell, T. 2018. “The transition from lead transparent to tin-opacified glaze productions in the western Islamic lands: al-Andalus, c. 875–929 CE”, *Journal of Archaeological Science* 94: 1-11.

Hyperspectral Imaging assisted by False Color Infrared techniques for ceramic's decoration studies. Achievements and Limitations

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The aim of the present paper is to demonstrate the achievements and limitations of the hyperspectral imaging techniques combined with false color infrared for studying the color decoration in ancient and historical ceramics. Today multispectral and hyperspectral imaging techniques with an emphasis in the near infrared region of the spectrum are the spearhead of non-destructive examination of cultural heritage objects, constituting a valuable tool at the service of archaeologists, art historians, conservators and researchers. However the bulk of the published results regarding these techniques concerns portable paintings, i.e. paintings on wood and canvas, while the available publications regarding the study of color decoration on inorganic substrates (e.g. wall paintings, pigment decoration on stone, ceramics etc.) are clearly fewer. In the present study two categories of ceramics are studied: four lekythoi belonging to the archaeological Museum of Piraeus dated in 425/430BC and ceramics shards from the collection of the Centre for the Study of Traditional Pottery - G. Psaropoulos Foundation in Athens indicative of the ceramics that exist in Greece from the 16th to early 20th century A.D. Hyperspectral imaging combined with false color infrared is applied to collect monochromatic images and spectral cubes in order to examine areas of different material composition and natural degradation, reveal the preparatory sketches and particularly detailed features or identify the pigments used. A Mu.S.I.S. HS system (by Forth Photonics) is used performing in 34 wavelengths between the region 400-1000nm. Through these case studies the authors want to show that spectral imaging techniques are powerful tools towards complete documentation, study and diagnosis and can offer much more possibilities than the common user can imagine provided that the application of the methods take into account the specific characteristics of the material and exploit its optical properties.

Study Gilding decoration on Mina’i ceramic of Rayy and Alamut in Iran based on microscopic investigation and ancient treatise

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Mina’i ceramic is one of the most important types of ceramic production in 12th-13th centuries in Iran that identified by stonepaste body and multicolored polychrome over-glazes painting. Mina’i wares are in some cases enlightened with gilding decoration. Abul-Qasim in his treatise which was written in 1301 AD, recorded ceramic gilding method and process. This paper focuses on gilded mina’i ceramics in order to identify gilding process and the gold/ceramic adhesion mechanism based on modern technological studies and this historical document. In this research, 5 mina’i sherds that excavated from Rayy historical region and Alamut castle in Iran were studied with chemical composition analysis, were measured using scanning electron microscopy, Micro particle induced X-ray emission method were characterized and identified the process and composition of gilded mina’i wares, Rutherford Backscattering Spectroscopy data were used to determine the cross section thickness, composition profiles of the gold layer and thermal treatment of the gold decoration. The investigations on gilded mina’i ware demonstrate that these shards have been gilded by gold leaf over base glaze surfaces. The analysis results indicate that iron base color glazed for red and chrome base color glazed for black has been applied to surrounded line over and under the pure gold leaves area. Although Rutherford Backscattering Spectroscopy data shows that the gold leaves layer penetrates into the base glaze the result of thermal process for adhesion mechanisms between gold leaf and its substrate. Additional results suggested that gilding method in these two sites (Rayy and Alamut) are the same but in the compounds of body and glazes are some differences. The results of this research confirms Abul Qasim’s writings concerning gilding process.

Study on glaze decoration technology and coloration mechanism of porcelain from Changsha kiln, Tang dynasty (618–907 A.D.), China

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Changsha Kiln was one of the most famous folk kiln in the history of the development of Chinese ceramics. Its kiln-site was located at Tongguan (铜官) county in Changsha city, Hunan province, south of China, so was called Tongguang kiln. It was established in the Tang Dynasty (618-907 A.D), declined in the Five Dynasty (907-975 A.D). And it made two recognized significant contributions to Chinese ancient ceramics: the invention of under glaze coloured porcelain and high-temperature copper-red glazes even in the whole world. Although in the tang dynasty, Changsha kiln had frequent ceramic trade with the world and was the cultural ambassador of China to the world, there were few records of the official history about it. It was not until the success of salvaging the sunken ship “Blackstone”, that 90% of the cargo was Changsha kiln porcelain that the world came to know Changsha kiln again, and hence, the craze of Changsha kiln research was also set off. In this work, by using VHX-2000 Super-high Magnification Lens Zoom 3D Microscope, Transmission Electron Microscopy (TEM), Scanning Electron Microscopy Energy Dispersive X-ray Spectrometer (SEM-EDS), and X-ray photoelectron spectroscopy (XPS), the phase structure, composition, and the microstructure of porcelain from Changsha kiln were studied, even the valence states of Cu and Fe corresponding to various colors in the colored glaze were systematically analyzed. The results confirmed that there are many decoration processes in Changsha kiln. There is phase separation in the glaze, and a phenomenon of accumulation of tin elements, although the role of tin is still unclear. Using the TEM to observe the micro shape of the metallic element aggregation region, and analyze their structure by electron diffraction, combining with EELS, it indicates that Cu0 is the major colouring element status of the red glaze.

Tuesday 17 Sep.

Development of new methods and techniques

Unveiling the Sicilian and Southern-Italian red-figure vases productions and technologies through synchrotron radiation techniques

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Classical investigation methods in ancient ceramics studies mainly include thin section petrography, powder diffraction, and chemical analysis. However, the application of a non-destructive approach is more advisable for investigations on valuable artifacts, on which sampling limits may be imposed. This is the case of the artistic production of red-figure vases, started in Sicily and South Italy in the second half of the Vth century B.C., imitating the Attic one, and continues until the beginning of the IIIrd century B.C. According to some scholars, the discovery in Southern Italy of some artifacts stylistically attributed to Sicilian production could suggest a transfer of painters from Sicily to these regions, with the consequent birth of new workshops; according to others, the origin of new workshops could be the result of a mobility of artifacts in the Tyrrhenian or Ionian area [1-2]. Of course, only advanced archeometric analysis can support this hypothesis over-passing the current discrimination based only on typology and style [3-5]. In this respect, synchrotron radiation methods, such as SR-XRD and SR-XRF, might allow to obtain in an easy, non-invasive, and fast way, both mineralogical and chemical data. In this prospective, a measurement campaign has been carried out on the MCX beamline at the Elettra synchrotron source (proposal n. 20180263), with the aim to improved knowledge on this class of vessels by analyzing a selection of potteries representative of the most relevant painters and workshops. The obtained results allowed exploring challenges posed by new instruments and applications; specifically, simultaneous mineralogical and chemical data have been acquired, providing useful discrimination criteria among the different red-figure productions. [1] A.D. TRENDALL, London 1989. [2] U. SPIGO, Bollettino d'Arte LXXII, 44-45, 1987, 1-24. [3] P. MIRTÌ et al., Archaeometry 46, 2004, 183-200. [4] P. MIRTÌ et al., Analytical and Bioanalytical Chemistry, 380, 2004, 712-718. [5] A. MANGONE et al., J Cultural Heritage, 2013, 82-88.

Image analysis in ancient ceramics characterization and provenance attribution: from optical microscopy to cathodoluminescence microscopy and spectroscopy

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Optical and electron microscopy are among the basic approaches in ancient ceramic characterization in order to unveil compositional features, textural and structural arrangement of mineral components. A part from the identification of mineral phases, the investigation of aspects as distribution, shape and abundance of inclusions by quantitative image analysis methods make it possible to establish correlation between textural/compositional features and production technology, recipes, and manufacture centers [1]. Recent studies demonstrated that statistical approaches applied on images acquired by different methods are able to overpass some limits and give back comparable results for the quantification of some textural features [2]. Since ninetens, some interesting case studies highlighted the potential of cathodoluminescence microscopy and spectroscopy in supporting classical imaging methods for ceramic technology characterization [3-4] and provenance determination [5-6]. In this respect, the possibility offered by the method in detecting and mapping phases, trace impurities and defect distributions of mineral grains can provide valuable additional data for the discrimination of different group of objects belonging to the same archaeological class. In this paper cathodoluminescence (CL) microscopy has been used for analysing a fine-grained class of archaeological ceramics from Volterra (Tuscany, Italy) dated back between Late Antiquity and Middle Ages. The combination of optical microscopy and CL has been used to trace differences in manufacture techniques and raw materials, evidencing limits and potential of the method with the support case of statistical analysis. [1] Dal Sasso et al., J. Arch Science, 46, 2014, 125-143. [2] Maritan et al., EMAC2017, 6-9 Sep 2017 Bordeaux (France) [3] Chapoulie et al., Archaeometry, 47, 2005, 519–534 [4] Bajnóczi et al., J. Arch Science, 40, 2013, 874-882 [5] Picouet et al., J. Arch Science, 26, 1999, 943–949 [6] Hunt, J. Arch Science, 40, 2013, 2902-2912 [7] Cantini et al., LABORATORIO UNIVERSITARIO VOLTERRANO 1996-2016, XVIII 2015-2016, 77-86.

Lead and strontium isotopes and their combination to elemental chemistry to trace ceramic circulation in Mesoamerica

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Recent studies in archaeological sciences successfully applied isotopic analyses to source ceramics. These studies demonstrate that isotopic analysis discriminates between ceramics from different sources, that ceramics record the isotopic composition of their raw material allowing to link ceramics to clay sources, that lead isotopic signature is robust to grain-size selection process applied to clays, and that combining two isotopic systems is efficient to source ceramics resulting from clay/clay-temper mixings (e.g., De Bonis et al. 2018 [Journal of Archaeological Science 94] 51-59, Renson et al. 2013 [Applied Geochemistry 28] 220-234, Renson et al. 2013 [Geoarchaeology 28 (6)] 517-530). In this research, lead and strontium isotope analyses are applied to Olmec-style ceramics from Mexico and the isotopic results are integrated to elemental chemistry data previously obtained by Neutron Activation. The two main objectives are: - to determine if the isotopic approach can discriminate between different production centers in Mesoamerica and could therefore contribute to trace ceramic circulation and confirm or refute existing hypotheses on interactions in the area, - to evaluate how the integration of isotopic and elemental chemistry improves our knowledge on clay sources, processes applied to clay and post-depositional processes and contamination. Forty fragments from multiple Olmec-style ceramic wares were analyzed. These samples were recovered from three sites (San Lorenzo, Canton Corralito and Tlapacoya) located in three different regions (the Gulf Coast, southern Mexico and the Basin of Mexico). The results show that the lead and strontium isotopic composition discriminates between the three production sites and allow identifying imports, and that samples unassigned by elemental chemistry are assigned using isotopic ratios. The integration of the isotopic and elemental analyses contributes in the identification of clay sources, mixing processes and in the evaluation of possible impact of diagenesis.

Estimating the Original Firing Temperature of Ceramics Using Biotite Study

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Biotite is a mineral group of dark micas and its chemical composition varies between end-members which differ in volume of Mg/Fe in octahedral sites and Al/Si in tetrahedral sites. Biotite is one of the rock-forming minerals which can often be found in a ceramic body. A certain content of Fe²⁺ which can always be found in natural biotite, except for pure phlogopite, allows using the mineral as an indicator of a temperature the ceramic vessel has undergone. Oxidation of Fe²⁺ is a thermally induced process which requires temperature that most of the earthenware ceramics have been fired at in the past. Biotite samples were fired in controlled conditions in oxidizing atmosphere at range of temperatures from 300 to 1400 °C with 100 °C per step with 30 min of soaking time. Experimental firing at 600 °C was extended with soaking times of 1, 2, 3, 5, 8 and 24 h. Oxidation of Fe²⁺ was observed by x-ray diffraction analysis (XRD), Mössbauer spectroscopy and also by polarising microscope. Biotite undergoes significant changes in pleochroism between temperatures of 500–700 °C, less apparent changes advance in the range of 700–1000 °C. Original firing temperature estimation using pixel intensity values histograms will be explained. Further reactions that take place during heating of the mineral are dehydration, structure decomposition and new phases crystallization. Changes in structure, biotite decomposition, leucite and magnetite crystallization were observed by XRD. Those reactions appear at temperatures higher than 1100 °C, which is above the temperature the most of archaeological ceramics are expected to be fired at. Chosen analytical methods provided wide range of data which allowed to make a list of physical properties changes during the biotite thermal decomposition that can be used for the purpose of original firing temperature of ceramics estimation.

Synchrotron radiation through the millennium. High resolution μ -XRPD for characterizing the ceramic's surface generated by heat transfer

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Ancient ceramics from Tappeh Zaghe in North West of Iranian plateau (5th millennium BC) are still unknown objects in archaeomaterial research, due to their manufacturing process. Archaeologist believed that they were two different types of ceramics in Tappeh Zaghe, according to their raw material. However, firing process might be developed from 5100 to 4900 in this site. The goal of this research is going to describe ceramic's surface by means of heat transfer based on different firings which were practiced on these two types of ceramics. Ceramic's surfaces that exposed directly to the heat flow created decompositions in crystals by means of degree of crystallinity versus thermal gradient. Characterizing the near surface crystal structure, synchrotron with high energy accelerators is achieved in studies associated to cultural heritage. Synchrotron has been developed to a multipurpose and powerful technique for near-surface investigations. It is also possible to achieve both total scattering experiments as well as high pressure diffraction. The objects are investigated via μ -XRPD at MSPD (Material Science Powder Diffraction) beam line at ALBA synchrotron, Barcelona which runs between 8 and 50 keV. This energy range sufficiently protects the investigated area of the samples at their near surface area. Indeed, different degrees of crystallinity assumed on the ceramic's surfaces exposed to heat flow which were derived from the new formed crystals as a function of heat gradient. They were two types of ceramics in Tappeh Zaghe from 5100 – 4900 millennium BC with different surface character based on the heat transfer.

Archaeo-ceramic 2.0: investigating ancient ceramics using modern technological approaches

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Since the first attempts to the petrographic analysis on pottery, a multitude of archaeometric studies have been carried out in the last century to solve important issues on provenance, production technology, function, dating and conservation of ancient ceramics. The advancement of modern instruments, the accessibility to facilities in the past devoted particularly to basic research or available only in few structures across the world, the development of accessible and fast processing software, as well as of a new class of scientists with important both analytical skills and sensibility for the cultural heritage, have been at the basis of a modern era of archaeometric studies. This contribute focus on the use of innovative approaches to solve archaeological issues, reporting some examples of new methods applied to mineralogical, petrographic and chemical analyses. The traditional microscopic characterisation of ceramic pastes, for instance, can now be easily coupled with quantitative analysis of abundance and size distribution of their textural features, through the application of digital image analysis, contributing in the definition of the pottery production choices and evolution over the time. As for the mineralogical analysis, the possibility of simultaneously processing numerous X-ray diffraction patterns by statistical tools, represents a modern way of interpreting possible differences or analogies in the production recipes and/or firing technology of groups of ceramics. Moreover, the modern micro-diffraction techniques, allow to determine the mineralogical composition of small-sized phases both in ceramic bodies and slips/glazes, supplying important information on the production technology and possible post-deposition processes. As for the provenance issue, relationships between also far way communities/societies can now be constrained not only on the basis of conventional bulk chemistry, but also by isotope analysis. These new methodological approaches give rise to a modern concept of archaeometric analysis on ceramic materials, that can be defined as archaeo-ceramic 2.0.

Individualised traditions. Tracing out pottery forming techniques through X-ray micro-CT in a pottery assemblage from Middle Neolithic Sesklo (Thessaly, Greece)

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The study of pottery primary forming techniques is a developing field of archaeological research which can be substantially boosted through the employment of new technologies like the industrial X-ray micro-CT. Contrary to many other hitherto applied methodologies (e.g. macroscopic observation, X-ray radiography, thin section analysis etc.), which are characterised by certain analytical limitations, micro-CT allows for the first time a highly precise, 3-dimensional representation of the potsherd's inner structure. Based mainly on the direct visual analysis of 2D virtual thin sections and 3D representations, micro-CT can reveal the traits of forming operations which remain as hidden traces in the inner of the vessel walls, such as the morphology of the construction units, and the type and morphology of their joins. In addition, metrological analysis, i.e. the precise measurement of each single void and inclusion of the ceramic fabric regarding position, size and shape offers a valuable support to the technological study of pottery, since the orientation of the ceramic fabric's elements is highly indicative of differences in forming actions. Micro-CT enables thus an incomparably elaborate reconstruction of specific forming techniques and chaînes opératoires. Thereby, it offers the possibility to figure out a series of strongly individualised craft behaviours, and approach the pottery production up to the level of the individual potter. This analysis puts in a new analytical frame the question of the relationship between the 'technological tradition' and the crafting individual itself. In the current paper, we will present the results of the micro-CT scanning of a pottery assemblage from Neolithic Sesklo (6th millennium, Thessaly, Greece). We will focus on three issues: 1. the potential and limitations of the visual and metrological analysis; 2. the methodological implications of micro-CT for the technological study of ancient ceramics; and 3. the technological pluralism observed among potters of Neolithic Sesklo.

A study on mechanical properties of 19th-century glazes from Bordeaux

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The aim of this paper is to contribute to document productions of a French ceramic industry: the Johnston-Vieillard manufactory. This factory located in Bordeaux, produced between 1845 and 1895, a special type of ceramic called “white earthenware”. One of the characteristics of this kind of ceramic, compared to so-called tin-glazed earthenware, is the hardness of its glaze. As a matter of fact, it was described in 19th-century treatises that boron was introduced in glazes – replacing lead oxide – to increase their hardness. The purpose of this study is to perform experiments by nanoindentation method to determine mechanical properties of archaeological glazes. We examined a selection of 80 sherds representative of five different production periods of the factory. These fragments came from waste dumps discovered during recent excavations located in the ancient area of production of the manufactory. Nanoindentation tests were performed to obtain relevant informations about Young’s modulus and hardness of glazes. Moreover, microstructure and chemical composition of glazes were investigated using Scanning Electron Microscopy-Energy Dispersive X-ray Spectroscopy (SEM-EDS). The detection and the quantification of boron probably present in 19th-century glazes is not possible by EDS, because it is a light chemical element. That’s why, we also employed Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) to determine boron content in glazes. By following the evolution of the chemical compositions of glazes over time, it has been possible to correlate the mechanical properties of glazes with their chemical composition. The results showed that variation in the glaze composition during the different production phases of the manufactory, involves a variability in the mechanical properties of glaze. It could appear that glaze hardness was not the only criterion influencing recipes within the production process. As a matter of fact, other factors could be at the origin of technical and/or aesthetic choices.

The automatic recognition of ceramic through only one photo. The archAIDE App

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ArchAIDE (archaide.eu) is a 3 year project (2016-2019) funded by the European Union’s Horizon 2020 research and innovation programme. The project has developed a new app that aims to improve the practice of pottery recognition in archaeology, using the latest automatic image recognition technology. Every day, archaeologists are working to discover and tell stories around objects from the past, investing considerable time, effort and funding to identify and characterise individual finds. Characterisation and classification of ceramics are carried out manually, through the expertise of specialists and the use of analogue catalogues held in archives and libraries. The goal of ArchAIDE is to optimise and economise this process, making knowledge accessible wherever archaeologists are working. ArchAIDE supports the classification and interpretation work of archaeologists (during both fieldwork and post-excavation analysis) with an innovative app for mobile (tablets and smartphones) and for desktops, designed to be an essential tool for archaeologists. Using deep learning technology and developing a dedicated neural network, the ArchAIDE app is able to quickly recognise single potsherds through a photo. The fragment is photographed, its characteristics sent to the recognition system, resulting in a response with all relevant information linked, and ultimately stored, within a database that allows sharing online. Tools for consulting the digital catalogues, for drawing the fragment and for organising data enrich the app and facilitate its use. The system currently supports shape-based recognition of Terra Sigillata Italica, Hispanica, South Gaulish and Roman Amphorae, and decoration-based recognition of Majolica of Montelupo and Majolica of València, as a proof-of-concept. The ArchAIDE app has been developed by an international team of more than 30 researchers, archaeologists, computer scientists from 5 countries (Italy, Germany, Israel, Spain, United Kingdom).

New trends in geochemical data grouping: supervised machine-learning methods and full-spectrum analyses

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This study reports geochemical analyses results on a series of samples from several production centres from Catalonia (NE Spain). Several data grouping methods are tested. The raw spectral data was obtained using energy dispersive X-ray fluorescence (EDXRF) spectrometry. Common methods to create reference groups are Principal Component Analysis (PCA) or dendrograms from Hierarchical Clustering Analysis (HCA); these belong to the so-called unsupervised methods and are useful for data of unknown origin (e.g. different pottery imports from a given site). Using PCA or HCA it is sometimes possible to unveil distinct groups corresponding to different origins. However, our main objective is not the identification of unknown groups but to find the compositional relationships that better describe already known groups. We intend to characterise contemporary pottery production centres in Catalonia. The scope of the study includes provenance, traceability and dispersion. In the geochemical database there is a known origin (Y) associated to each analysed sample (X). For these cases supervised machine learning models are very convenient. These methods use algorithms to learn the function that links the input (chemical analysis) to the output (origin). The goal is to approximate that function so well that then it is possible to predict Y for data of unknown origin. First, the model uses the 80% of the dataset to define a model, and then the remaining 20% is used to validate its goodness. Several models have been used, among others, Random Forest, Generalised Lineal Models, Lineal Discriminant Analysis and K-nearest Neighbour. Stack of methods have been used too. Finally, besides elemental analyses, raw EDXRF full scan data have been used as starting strategy. The results indicate high accuracy values in the confusion matrix from the models. All in all, these models can make distinctions between very similar geochemical groups which unsupervised models could not distinguish.

Wednesday 18 Sep.

Production centres and raw material studies

Ornamental and technological transitions within LBK and from LBK to SBK period (Eythra, Saxony)

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Archaeometrical characterizations were carried out on Neolithic pottery from Eythra (Saxony, Germany) dated from about 5400 BC to 4500 BC. Representative LBK and SBK potshards were analyzed using CT, optical microscopy, XRD, XRF, DTA/TG, Moessbauer and Raman spectroscopy. Matrix and temper of the shards were selectively studied due to firing parameters and raw material provenances implying chemical, physical and mineral data as well as 2D- and 3D-fabric characteristics. Their statistical application reveals that the ornamental transition from LBK to SBK at ~ 5100 BC does not show changes of pottery techniques. In contrast to this, a technological change from organic-temper ceramics to inorganic-temper pottery occurs during the transition from oldest to older LBK. The organic-temper material was fired at temperatures at ~ 600°C - 700°C, whilst inorganic-temper materials implies different temperature ranges between ~ 650°C - 930°C. Organic inclusions are degassed resulting in negative imprints of the primary matter, whilst oldest LBK potshards show remaining organic matter. Pottery containing organic material may be suggested being more resistant to breakages and therefore better suited for transportation. The provenance of raw materials deduced from of the shards compared with original raw material may be attributed to two or three sites, but cannot be selectively attributed to LBK or SBK potteries. The studies reveal that the Neolithic production techniques depend on intended uses of the vessels. With reference to literature, the LBK pottery characteristics may be attributed to the transition from migrating to semi-settled populations or Neolithic expansions. The results should also contribute to time and genetically related Neolithic population trajectories with a south-east to north-west dispersal. Method-critics are given for analytic data as well as statistical calculations implying original and differentiated data as well as real and fictive mineral contents.

Elemental analysis of pottery from the Early and Middle Bronze Age necropolis of Lapithos. The early history of a long-lived production centre in Cyprus

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Lapithos is well known in the Cypriot archaeological literature as a significant centre of pottery production from prehistory to the 20th century AD. Despite the fact that we are still missing material evidence deriving from workshop contexts for the Bronze Age segments of Lapithos’ long history, the large corpus of pottery recovered from the region’s ancient cemeteries, and the distinctive stylistic attributes of Lapithos ceramics, leave little doubt that the area’s long-standing ceramic traditions go back several millennia. In order to shed light on the history of this important potting centre, and provide a solid reference for compositional analysis of suspected Lapithos ware found elsewhere, a comprehensive research programme was undertaken with the aim of defining the compositional and technological profile of pottery production at Lapithos - and transformations therein - during the Bronze Age and beyond. Ceramic sample selection followed a detailed morphological study of the ceramic assemblages from the 1913 and 1917 excavations at Lapithos Vrysi tou Barba, which provided the ideal conditions for an analytical study of a large, contextualised and well documented ceramic sample from Early and Middle Bronze Age Lapithos. In this paper, we will present the results of the elemental analysis of ceramics from the necropolis of Vrysi tou Barba, using portable X-ray fluorescence spectroscopy, laboratory wavelength-dispersive X-ray fluorescence spectrometry, and neutron activation analysis. A smaller number of targeted pottery samples were also analysed with polarising optical microscopy and X-ray diffraction. Results allowed us to assess the extent to which the main wares recognised macroscopically correspond to distinct compositional or technological groups, and to identify compositional differences among pottery that on stylistic criteria is thought to have been locally produced at Lapithos and vessels that are understood to be imports from other regions of the island. We will present the compositional and technological profile of pottery production at Lapithos and discuss the implications of results for our understanding of the organisation mode of ceramic production and distribution in the area during the Early and Middle Bronze Age.

For a “best practice approach” to experimental reproductions of ancient pottery: on-site testing of raw clay with archaeological tools and installations. A pilot study from Bronze Age Crete

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Over the past 20 years experimental archaeology has been extensively used in the study of Bronze Age pottery from Crete, mainly as a means to ascertain whether and to what extent Minoan potters had developed wheel-throwing skills in the II millennium BC. All the experiments were conducted with an electric wheel and industrial clay, and led to the conclusion that Minoan vessels were wheel-fashioned rather than wheel-thrown, i.e. made with coils and finished on the wheel. Hand-forming techniques have instead attracted less interest as they were considered easy to learn and easy to execute, based as they are mainly on the energy exercised by the potter’s hands. In fact, a few scholars proposed that moulds -in stone or ceramic- were used for the production of certain type of cups but the idea was dismissed by the majority of researchers due to the lack of positive evidence: only in the case of medium size round-based vessels was it accepted that broken vessels could have been used as shaping supports for hump-moulding. The discovery of a long-term pottery production area in the ceremonial/palatial centre of Phaistos has on the one hand clarified that local potters made extensive use of ad hoc tools in the form of re-purposed vessels, which could be used as shaping supports/moulds; on the other it has suggested that the use of moulds and/or wheel was a means to produce en mass a distinctive type of handleless cup that was crucial to the activities performed at the site. This hypothesis was positively tested through a series of targeted experimental reproductions carried out on site, with clay that was mined from a local source, was tempered with local sand and was modelled with moulds/shaping supports found in the area, or with identical reproductions. Wheel-throwing was in particular positively tested with a hand-turned wheel that aside from representing an exact replica of a Minoan wheel, is still in use in the potters’ village of Thrapsanos, in Crete.

Geochemical and petrographic insights into the pottery production during the Chalcolithic South-Central Iran

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The main purpose of this project is to grasp the general history of communities of the pottery production during the Chalcolithic period (c. 5,000 - 4,000 BCE) in Marv Dasht plain, South-Central Iran through multidisciplinary studies of ceramic materials. The specific aim of this paper is to measure and describe the geochemical compositions, petrographic characteristics, the presence of minerals of the ceramic materials in each site and ware-type, thereby clarifying the production steps of clay acquisition, tempering, firing, and their diachronic changes. This paper presents the combined results of Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), X-Ray Diffraction (XRD), and thin-section petrographic analysis. The analysed materials are 60 potsherds samples from five sites belonging to different phases of the so-called “Bakun period” (early: Tall-e Jari A and Tall-e Bakun B; middle: Tall-e Gap and Tappeh Rahmatabad; late: Tall-e Bakun A). ICP-OES results suggested that the geochemical compositions were more clearly separated between ware-types than between sites. It also implies the presence of at least three different clay sources for black-painted ceramics while those for vegetal tempered coarse ceramics were local and different each other. XRD results indicated the presence of diopside and gehlenite in the black-painted ceramics from the early phases, implying the firing temperature higher than 850 °C. The firing temperatures of the black-painted ceramics also increased over time. Petrographic observations contributed to the characterisation of mineral temper in coarse ceramics and the possible sources of the mineral temper. These results corresponded to the results of the archaeological analysis, such as a notable increase in the amount of the black-painted ceramics and the changes of the other aspects of production techniques, providing the new insights into the history of communities of the pottery production.

Elemental Distribution and Raman Spectrum Analysis of Raw Material Characteristics of Ancient White Pottery

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By using the mapping function of energy dispersive X - ray fluorescence spectrum analysis and Raman spectrum analysis, the element distribution and phase structure of white pottery in Neolithic period unearthed from typical sites in the Yellow River Basin were analyzed to understand the raw materials and technological characteristics of this special pottery. The experimental white pottery samples in this work are from the Shanxi Taosi site, Wadian site of Henan Longshan culture, Tonglin and Liangchengzhen sites of Shandong Longshan culture, Erlitou and Nanwa sites of Erlitou culture, all unearthed from archaeological excavations. The results show that anatase and hematite are widely distributed in the white pottery of various sites, which is one of the main mineral characteristics of natural kaolin, and using coal-series kaolin is found in the gray white pottery of Erlitou site. The particle distribution of feldspar in the white pottery of Liangchengzhen site is particularly prominent, with the existence of epidote and actinolite in some samples, indicating that the white pottery of Liangchengzhen site use special raw material. Some white pottery has a calcareous layer on its inner surface, which is residue in the cooking process of ancient people using these utensils. From Longshan culture to Erlitou culture, white pottery has always retained its function as a water cooking utensil, which changed the previous academic understanding of white pottery as a ritual utensil.

Nought Point Two Per Cent Titanium Dioxide: A Key To Song Ceramics

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Iron oxide is well-known as the main provider of colour in Chinese high-fired glazes of the Song Dynasty (AD 960-1280) where it gave various tones of green, blue, cream, amber and black. In most cases the iron oxide was not added separately but was already present in the glazes' main ingredients, usually siliceous rocks, siliceous clays and botanic ashes. However, what is perhaps less well known is that Song dynasty glazes also owe much of their colour to the presence of another earthy oxide – that of titanium – also introduced naturally through the glazes' major raw materials. Perhaps the most remarkable aspect of titania's role in Song ceramics lies in its modifying effect on iron oxide and in its ability to promote significant color-differences in both glazes and bodies. The main effect of rising titania levels is to render bluish celadon glazes greener, and make oxidised porcelain glazes yellower. As a result titania is often the deciding factor in whether a stoneware glaze can be regarded as having true Imperial quality, or whether a porcelain glaze can show the white material beneath to its best advantage. A further significant aspect of the 'titania effect' is that the amounts involved are both small and rather precise – typically 0.2 wt% TiO₂ and below in both Chinese Imperial stoneware glazes and in fine northern and southern porcelain glazes. Above these levels the ceramics quickly become more ordinary and less impressive in their material qualities, so this figure can be regarded as a key proportion in the understanding of Song Dynasty glaze-colour. The existence of this underlying principle becomes evident when the many hundreds of published analyses of Song glazes are reviewed from three aspects – namely fired colour, iron oxide content, and the amounts of titanium dioxide present.

Geochemical Warfare: Exploring Elemental Patterning within Emperor Qin Shihuang's Terracotta Army, China

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Emperor Qin Shihuang's 'Terracotta Army' is a ceramic assemblage of immense scale and importance. These c. 7,000 ornate life-sized ceramic soldiers and horses were installed in battle formation in three underground pits, outside the tomb of the first emperor of China, in order to protect him in his afterlife. The terracotta army and the wider 20 km² mausoleum complex that it forms part of was built between 247-210 BC and may have involved 700,000 craftsmen and labourers brought in from across the Qin Empire. Detailed morphological, spatial and compositional analysis of these and other mass produced objects unearthed from the site, are providing key insights into the organisational strategies behind the realisation of a project of such extreme size including the division of labour, quality control and standardisation. Such information is of prime importance for our understanding not only of the mausoleum itself, but also the nature Qin Period China more generally. This paper presents the results of new data on the geochemical composition of a selection of complete statues from Pit 1, which feature stamps or inscriptions that may be indicative of the workshops that produced them. Examples of foot-soldiers, charioteers, middle-ranking officers, civil officials and terracotta horses have been analysed using a bespoke pXRF calibration and their intra and inter-compositional variation has been explored and interpreted in the light of current theories about the technology and organisation of ceramic production at the site.

The patterns and constraints in the production of Capacha pottery: geochemical and petrographic characterization of a Mesoamerican Formative ceramic assemblage

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Capacha (1500-800 BCE) remains the oldest ceramic assemblage known from western Mesoamerica. It dates to a period when village life became widely established, and some of the first evidence of social stratification and craft specialization appeared. In this way, its study is a valuable window into a critical moment in the Mesoamerican cultural development. Here are presented the results of the X-ray fluorescence (XRF) and thin-section petrography compositional analyses of 90 Capacha pottery samples from two sites in the Colima Valley, along those of 10 raw clay samples from the same area. This represents the largest and first proper archaeometry-based study of Capacha pottery production. The study aimed to source the pottery raw materials, identify the technological patterns in the production sequence (raw material processing, manufacturing techniques, etc.), and the material and socio-technological constraints of production (resources availability, technological knowledge, etc.). Any pottery circulation patterns could be uncovered by sourcing and the distribution observed in and between the two sites sampled. The compositional and technological characterization of Capacha pottery allowed to observe the degree of variability in the different steps of the production sequence and to establish technological and compositional groups, as well as the correlation of these groups with the sites and the range of pottery forms and types. Therefore, it was possible to observe how the sites compared in terms of raw materials procurement, shared technological knowledge, and pottery consumption patterns, and ultimately gain a first insight into the social and economic organization of the people behind this pottery.

The background is a solid blue color. It is decorated with several abstract, geometric shapes in shades of orange and brown. These shapes are scattered across the page, some appearing as simple polygons and others as more complex, layered structures that create a sense of depth. The shapes are primarily located on the left and right sides, leaving the center area more open for the text.

POSTER SESSIONS

Monday 16 Sep.

Session 01 11.30-12.30

CHRONOLOGY AND DATING

1

A case of conflict between archaeometric and stylistic dating of a glazed ceramic statue from Albisola (Liguria, northwestern Italy)

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1 University of Genova 2 University of Leiden 3 University of Milano-Bicocca 4 National Research Council

In 1965, Costantino Barile (1886-1968), a pioneer in the study of ancient Ligurian ceramics, published and described a small glazed ceramic statue called Cristo con le mani legate. The author did not attempt any evaluation about provenance and chronology, but he simply reported that the piece was discovered in a very old building on the hills of Albisola Marina (Liguria, northwestern Italy). Anecdotic oral information, however, reports that Barile was convinced that the piece was much older than its peculiar style would have suggested. Indeed, it is very similar as for glaze and decoration to the classical Taches noires ware produced in Albisola between the late 18th and the mid 19th century. This research aims to bring together and match stylistic, archaeological and archaeometric information to better elucidate both the provenance and the production period of the ceramic statue. The study by means of thin section, SEM-EDS and ICP-OES analyses pointed out the compositional and technological similarity of the statue with the Albisola Taches noires references, supporting the stylistic evidence. On the other hand, thermoluminescence analysis is in contrast with these results, indicating an earlier chronology (16th-17th century), thus creating a serious mismatch between archaeometric and stylistic-based dating. This finally provides an explicit case in which a meaningful solution must be found to reconcile conflicting conclusions. Paradigmatic consequences on classification and conservation issues are discussed to highlight the importance of multi-source information.

PROVENANCE AND NETWORKS

3

Amphoric epigraphy and Roman Open Data: Laietanian wine amphorae as a case study

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1 CEIPAC - Universitat de Barcelona

In recent decades, studies in Roman ceramic commercial distribution through its epigraphy have been benefited by the incorporation of new digital tools and methods with the purpose of its categorization and further analysis. For many of us, digital natives, methods set up 30 years ago by the first generation of “digital pioneers” turn out to be a useful tool on the development of research. Upon the monumental compiling works of the epigraphic corpora along 19th and 20th centuries we must add, in the late 80’s (and beyond), the integration of this information at online databases. Whereas, in its first phase, these databases stood out for its cumulative features like traditional epigraphic catalogues. A small number of these online corpora, in a second phase, has continued with the exploration and evaluation of the data with new technics and analysis methods. In this last case, projects such as EAGLE (within Europeana) or EPNet are good examples. The first one is an online multilingual collection of millions of digitalized articles from European museums, libraries, record offices and multimedia collections. The second one, a CEIPAC’s original project, which has the purpose of establish an innovative frame for the research on the political and economic mechanisms that characterised commercial dynamic system in the Roman Empire period. This current study will approach the production of amphorae with epigraphy at the Regio Laetana (Hispania Citerior Tarraconensis) for understanding the diverse phases of commercialization and distribution of laietanian amphoric wine along the western markets of the empire. To that end, CEIPAC’s database will prove to be very useful, which currently has near 45000 different ceramic epigraphs, compiling substantial works and papers dedicated to ceramic epigraphs at northwest Tarraconensis. Thus, we would research having the full range of about 2849 stamps from the Tarraconensis province within CEIPAC’s database. As a result, the Laetana region will be analysed, with its productive centres, its most known amphoric stamps and their distribution on the imperial economic networks and its commercial influence. Special emphasis will be placed on the problems and difficulties derived/created by studies of ceramic productions on dense productive areas such as Laetania and how surpass them with new and wide perspectives, through new methods and study tools as Roman Open Data, the visual interface created in the EPNet project.

4

Approaching the colonization processes of the Late Iron Age in the Black Sea region: North-Central Anatolian pottery and its import to the Northern Black Sea area

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Changes in material culture in North-Central Anatolia at the end of the 7th BCE and beginning of 6th BCE indicate starting of the Late Iron Age. Being developed in the Kızılırmak (Halys) basin, the unique painted pottery tradition spread to western part of the Kızılırmak, where it was developed by Phrygians, and, finally, can be seen in a wide geography of Anatolia. This painted pottery tradition in the Late Iron Age was developed by local Anatolian people

under the influence of Phrygian culture. Major settlements from north to south of the region are Sinop, Akalan, Ladik/Köyiçi Tepesi, Oluz Höyük, Maşat Höyük, Eskiypar, Boğazköy, Alacahöyük, Uşaklı Höyük, Çadır Höyük, Alişar, Kaman-Kalehöyük, Kültepe, Sultanhanı and Suluca/Karahöyük. The ongoing archaeological excavations of several Northern Black Sea settlements have revealed a significant amount of Anatolian pottery. It must be emphasized, that the Greek cities of the western coast of Asia Minor, which were the pioneers of colonization, had rather close relations with the nearest neighbors in Anatolia - Lydians, Carians and Phrygians. It seems rather obvious, that the Anatolian people took part not only in trade with the Greek cities (it can be attested by the growth of the Greek ceramic export to the inner areas of Anatolia.), but also in formation of their population. In other words, in the stream of the first Ionians to the Black Sea coastal area there were representatives of Anatolian people. It is difficult to define the amount of Anatolians in the Northern Black Sea area, because finally they were dissolved in the environment of mass of Ionian colonists and local population. This work focuses the pottery from the North-Central Anatolia in the Late Iron Age, its peculiar features and distribution in the Northern Black Sea area, basing on the results of the recent research.

5

Archaeology of the first hunter-gatherer in Buenos Aires (Argentina): La Noria site

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La Noria is the first hunter-gatherer archaeological site found in Buenos Aires (CABA, Argentina). Recent fieldwork campaigns have revealed the existence of likely more than one base camps for these Prehispanic hunter-gatherer groups who exploited the alluvial resources from Estuaric Plain and a small sector from the Pampean Plains. In Las Norias, pottery assemblages were found showing similar formal features to the northeast Pampean ceramic tradition. In order to advance in the understanding of the distribution and consumption patterns of the first hunter-gatherer groups in the region, a set of 20 ceramics have been analyzed by an array of multiple analytical techniques. Thus, chemical, mineralogical and microstructural analysis by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS), X-Ray Diffraction (XRD), Optical Microscopy (OM) and Scanning Electron Microscopy (SEM) analytical techniques have been carried out. The provenance of the ceramics, as well as their technological and production features, have been assessed, revealing the existence of a complex distribution of ceramic compositions clustering in five chemical groups. As expected, and according to mineralogical examination, the ceramics from La Noria show mineralogical characteristic features compatible with low firing temperatures.

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Archaeometric analysis for the characterization of ceramic fabrics and local clays from late Helladic Kastrouli (Central Greece)

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The present study deals with the characterization of a ceramic assemblage from the Late Mycenaean (Late Helladic III) settlement of Kastrouli, at Desfina near Delphi, Central Greece (E37o 54 19.56, N42o 50 792.35) using various analytical techniques. Kastrouli is located in the strategic position supervising the Mesokampos plateau and the entire peninsula, and is related to other nearby coeval settlements. Experimental briquettes made from clayey raw materials collected in the vicinity of Kastrouli, were fired under various temperatures (700, 900 and 1050oC) in oxidizing conditions aiming to compare them with the ancient ceramics. In total 22 ceramic sherds and 8 samples of the local clays were analyzed through mineralogical, petrographic and microstructural techniques. The petrographic analysis performed on thin sections prepared from the sherds using a polarizing microscope has permitted the identification of two main fabric groups, one small group and three singletons. Fresh fractures of representative sherds were further examined under a scanning electron microscope (SEM/EDS) helping us to classify them into calcareous (CaO>6%) and a non-calcareous (CaO

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Archaeometric analysis of Black Paint Potteries from Pompeii

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Campania, a southern Italian region, was one of the major production centres of black paint tableware, a high-quality ceramic ware, produced with red purified clay and covered by a glossy and compact black layer. The production of this ceramic class, known throughout the western Mediterranean basin, spans the centuries from the middle of the 4th to the 1st BC. The present work is aimed to increase analytical data in the study of Campanian black paint ware, by the analysis of samples from the Sanctuary of Venus Fisica (Pompeii), dating back to the middle of the 2nd to the first half of the 1st century BC. The samples were chosen as probably produced in other Italian production centres such as Cales (Caserta), Pyrgi (Rome), Apulia and southern Lazio. A multi analytical approach including Optical Microscopy, X-ray Powder Diffraction and Scanning Electron Microscopy is applied to investigate the mineral-

ogical and petrographic features of these artefacts, to identify differences among samples, to reconstruct the production processes and the provenance of the raw material. Petrographic observations of microstructure, groundmass and inclusions highlight the occurrence of four petro-fabrics. The mineralogical assemblage is characterized by abundant quartz, K-feldspar and plagioclase, common biotite and pyroxene, rare fragments of siliceous rocks, nodules of iron oxides and microfossils. The occurrence of primary calcite and rare gehlenite suggests a firing temperature below 950 °C. All samples have an aligned porosity, regular thickness of the ceramic walls and spiral traces on the surface that suggest the use of the potter's wheel for their production. Furthermore, the composition of the black painting on the surface is similar to the bulk, suggesting the use of the same pottery's clay mixture (barbottina), carefully purified and enriched in Fe-oxides and hydroxides. Chemical investigation on specific inclusions allows discriminating samples from different production centres.

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Archaeometric investigation of the Early Roman Ware 1 from Cartagena and Elche (Spain)

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The so-called Early Roman Ware 1 is common in the Eastern part of the Iberian Peninsula. In particular, in Cartagena, the ancient Carthago Spartaria, it is relatively common in the 2nd and 3rd century AD contexts. The macroscopic characteristics, with grey fabric, and the typology seem to indicate that these ceramics were kitchen items. The typology is well represented by a cooking pot with a conical body, everted rim and umbilicated bottom (type ER-W1.3A), as well as a casserole of globular body and narrow neck (type 2), and a lid. Although considered as a local product in Cartagena, Reynolds identified this ware as Early Roman Ware 1 in the area of Alicante. Certainly, the presence of examples of this ware in Elche and Valencia, for instance, opens the possibility that this ware was widely distributed across the region. The question here is whether all the products come from the same workshop and then distributed regionally or if different production areas were producing similar ceramics. To explore this problem, we have initially archaeometrically characterized, using a combination of techniques, 20 samples from this Early Roman Ware 1 found in Cartagena (Murcia) and Elche (Alicante). WD-XRF was used for the chemical characterization, XRD for the mineralogical characterization, and, finally, optical microscopy by thin-section analysis was applied to investigate the petrographic features. Both the results of the chemical and the petrographic characterization indicate the existence of a great diversity of products and reflects a much more complex reality in terms of provenance of this Roman ware.

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Archaeometric Study of Late Bronze Age and Iron Age Hand-made Pottery from Southwestern Mallorca (Spain): Distribution and Social Cohesion Strategies

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This contribution presents the results of the analysis of a set of 109 Late Bronze Age and Iron Age hand-made ceramics recovered in three archaeological sites located in the Santa Ponça area (SW Mallorca, Spain). These sites are placed in the same territory and at a short distance one from each other, thus existing a close spatial connection between them. Furthermore, the three archaeological sites studied are associated with different functionalities: a ritual and funerary site (Staggered Turriform of Son Ferrer), a village (Puig de Sa Morisca) and a manufacturing site (Turó de les Abelles). The chemical composition of the 109 ceramics was analyzed by means of WD-XRF and the different fabrics present in the ceramic record were identified by optical microscopy using thin sections. Finally, the typology of the vessels and the changes in settlement pattern observed in the area were also considered in the interpretation of the results. This complex analytical strategy allowed us to relate certain groups of samples to specific sites, to characterize the technological choices existing in the study area and to address the distribution of vessels between the sites from this territory. In addition, diachronic differences could be observed regarding pottery technology and the strategies applied by the prehistoric communities to promote social cohesion through ceramics. While in the Late Bronze Age and Early Iron Age social cohesion was based on a great technological homogeneity (e.g. in the kind of raw materials and recipes used), we see how in the Late Iron Age this cohesion is generated through the shared use of certain pottery types and their deposition in specific spaces that have a high symbolic load.

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Byzantine Glazed Wares in White Fabrics ('Glazed White Wares') Discovered in the Frankish Area at Corinth: Chronology, Provenance and Technology

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Excavations carried out at the Frankish Area at Corinth have revealed several dozen fragments of lead-rich glazed Byzantine ceramics in white fabrics, usually known as 'Glazed White Wares'. Two main styles are represented: Glaze White Ware II (GWW II), decorated with incised geometric patterns and characterized by an olive-green transparent glaze that is applied directly onto the ceramic fabric; and Polychrome Ware, characterized by painted designs in black, white and blue opaque glaze. These wares are represented at Corinth by bowls, dishes and cups found in closed and homogeneous deposits, several of which also produced Italian bankers' jetons and mould-blown glass objects attributed to the Florentine domination of the city, from 1358 onwards. The archaeological contexts of the glazed pottery fragments indicate a particularly late chronology of these wares. GWW II and Polychrome Wares are found in late 13th- and 14th-century contexts at Corinth, while on other sites, these styles are generally considered as no later than the 12th century. This poster proposes a synthetic approach to the archaeological and chronological contexts of the Glazed White Wares found at the Frankish Area. It also explores the diversity of pottery shapes, fabric colours and textures, and decorative patterns. By combining petrography, XRD, WD-XRF, p-XRF, Raman spectroscopy, and SEM-EDS, we investigate the provenance, the production and decoration techniques of the ceramics. The results indicate that GWW were imported at Corinth from various Mediterranean regions in the late 13th and 14th centuries, notably the Adriatic basin (Croatia, Marches), the Black Sea area, the northeastern Peloponnese. Decorative techniques were regionally-defined, particularly for what regards slipping, underglaze decoration and glazing materials. The overarching aim of this research is to provide a foundation to explore the late production and use of GWW of Byzantine stylistic tradition in post-Byzantine contexts in the Aegean region.

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Byzantine siphon from Novgorod

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During excavations in the city of Novgorod fragments of unusual jug were found in the first half of the 12th c. context. This jug had a hollow handle and hadn't any analogues among the local ceramics. Archaeological finds of similar vessels are known on the territory of Bulgaria (in the Rhodopes), Greece (in Monemvasia, Nemea, Fesos and in the southern Rhodopes) and Asia Minor (in Pamukkale, i.e. Byzantine Hierapolis, and Troy) in the 12-13th cc. contexts. But identical vessels still continued to use in certain areas of the Byzantine world to Modern time. For example on the island of Naxos. A whole spectrum of guesses about purpose of such vessels exist. The most popular was the version of the Bulgarian archaeologists about this vessels as devices for the distillation of liquids, incl. obtaining alcohol. But the ethnographic materials from Naxos (Greece) and Bulgaria, where such vessels were preserved in everyday life until the 20th century. They were intended for pump over wine from large pithoi or barrels, using a long tube, lowered into the pithos with wine and inserted into the lower end of the hollow handle. Greek name for these vessels is "siphons." Judging by the contexts of the finds, the "siphons" became popular in the 11th century (for an earlier time, they are not known) and were used until the Turkish conquest of Byzantium, when winemaking in the Aegean region fell into disrepair. Such jugs could be used in Russia for the same purposes as in Byzantium, i.e. to get liquids (wine, beer, honey) from amphora or barrel.

Chemical and petrographic study of 18th century Taches noires glazed ware from Haiti

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Archaeological excavation and survey of 18th century sugarcane and indigo plantations in Fort-Dauphin, northeast of Haiti, revealed numerous ceramic sherds attributable to European productions. These areas are mostly dated to the French colonization period (circa 1700-1800), yet they were probably reused later. We will present here the results of a combined study by means of ICP-OES, SEM-EDS and thin section analyses of the so-called Taches noires wares. This high-lead glazed tableware, characterised by informal black (manganese) decorations, was created in Albisola, Liguria (northwestern Italy) in the 18th century. It soon became a global pottery, reaching also several places in America, because of its high aesthetic and technological quality. It was also imitated in many workshops of Spain and France, but the early imitations were of low quality. However, after circa 1820, Ligurian potters started to move, transferring their knowledge abroad, because of the economical crisis of Albisola due to the duties imposed on Ligurian imports by Spanish and French governments. This research aims to understand the origin of the Haitian sherds by the comparative study with a database including original Albisola Taches noires samples as well as imitations from several Catalan and Provençal workshops. On the one hand, the possible Ligurian provenance would confirm the great spread of the Taches noires ware, and particularly its exportation by the French. On the other hand, if the ceramics were manufactured in France or Spain with Ligurian techniques, it could prove that the newborn Haitian Republic continued to maintain commercial connections with France after its independence (1804).

Dion and the pottery supply and distribution systems of the Aegean in Late Antiquity (4th-7th c. AD)

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The ancient city of Dion, which lies below the foothills of Mount Olympus, constitutes one of the most extensive archaeological excavations in Northern Greece (A.U.Thessaloniki). Dion is mostly acknowledged for having served as the religious centre of Macedon in the Classical and Hellenistic periods, while it reached its heyday during the Roman imperial times. Of particular interest is also the Late Antique phase of the city that has yielded a great wealth of finds. The purpose of this paper is to present some preliminary results of our ongoing research on the related pottery and its use to investigate the socio-economic profile of Dion in

Late Antiquity. The plethora of imported ceramics known from the above period suggests the existence of an economy that was well-integrated into the trade route network of the Aegean. By drawing on this extensive material, we can monitor the changes that occurred over time in the sources of supply of imported goods reaching the city through direct or indirect commerce. One feature common to most assemblages dating from the late 3rd to the early 7th c. AD is the strong presence of products from mainland Greece or the islands and the north-western Asia Minor coast. The 5th and 6th c. saw a pronounced rise in the circulation of amphorae from the eastern provinces, whereas the significant quantities of Black Sea amphorae in contexts of the 3rd-4th and, to a lesser degree, the 6th c. are of substantial importance, since, according to the prevailing view, Pontic amphorae reached the Eastern Mediterranean only occasionally in Late Antiquity. Consequently, the example of Dion can make a decisive contribution to our knowledge on the supply and distribution of Late Antique pottery in the Aegean, especially given that it comes from the northern part of the region which has largely been left out of the scope of modern research.

Fields of sherds: an integrated study of prehistoric ceramics across the cultural landscape of western Thessaly, Greece

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The ongoing interdisciplinary landscape project 'Land reclamation and the cultural record of the Kambos, western Thessaly, Greece' (LTNS: 2014 –), carried out by the Ephorate of Antiquities of Karditsa and a large international team, is revolutionising our understanding of the archaeology of western Thessaly. The traditional image of an unpromising and underpopulated region is changing drastically to an intensively inhabited and constructed landscape from the mid-7th millennium BC and throughout the prehistoric and early historic periods. Our cutting-edge methodological workflow, combining state of the art Remote Sensing, archaeomorphological and geoarchaeological analysis with extensive and intensive surface survey, high-resolution, palaeoenvironmental, bioarchaeological and material culture studies provides a fresh understanding of the use of space and the lifeways of the prehistoric communities of western Thessaly. An integral part of the LTNS is the systematic study of the surface prehistoric pottery collected from both extensively and intensively surveyed sites through macroscopic and ceramic petrographic analysis. The main aims of the pottery study are to establish a relative chronology for the located sites, to identify different chronological phases, to estimate the extent of sites and interpret the use of space. Moreover, a significant goal is to collect evidence on the diachronic and synchronic characteristics of pottery technology, production, consumption and circulation across the landscape. The preliminary results of this interdisciplinary study have indicated that the area was characterized by diachronically stable habitation already from the Early Neolithic and throughout the following periods up to the Late Bronze and Iron Age. As for the pottery production, it is integrated in the regional circles, though retaining its local attributes, and participating actively in the multiscaled

contact networks operating along periods and across regions. Most importantly, the results of this pottery study demonstrate the dynamics of an integrated methodological approach in the study of surface past ceramics and its potential to provide data on multiple issues of archaeological research.

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Imported pottery at Tintagel, Cornwall: understanding networks connecting the Atlantic and Mediterranean in Late Antiquity

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This poster presents ongoing analysis of imported pottery, dating to the 5th/6th century AD, from the coastal promontory site of Tintagel, Cornwall, in the south-west of the United Kingdom. Imported ceramics, particularly Aegean and East Mediterranean amphorae and finewares, as well as pottery of other Mediterranean and Atlantic origins, have been recovered at the site for over a century, and continue to be excavated. This poster shares details of a British Academy Postdoctoral Fellowship project, involving a collaboration between Newcastle University and the Fitch Laboratory at the British School at Athens, which aims to provide a full assessment of this ceramic assemblage. The study focuses on the stylistic, as well as compositional (mineralogical and elemental) characterisation of the whole pottery assemblage, and an investigation of provenance to reveal new understandings of the networks of contact and exchange that linked Tintagel with the Atlantic Seaboard and Mediterranean in Late Antiquity. This paper will present the sampling strategy and preliminary results of the petrographic analysis of the main types of transport amphorae recovered at Tintagel.

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Late Medieval Besztercebánya (Banská Bystrica) stove tiles: provenance and production technology

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A unique collection of high-quality late Medieval (15-16th century) glazed stove tiles from the northern part of the Carpathian Basin is of great interest to archaeologists and art historians. It is yet to be determined whether these products characterized by similar features were made in a single workshop, perhaps in Besztercebánya/Banská Bystrica (in present-day Slovakia), or in multiple workshops in the region. The ceramic body and glaze of ninety-four tile fragments were investigated from six sites (Besztercebánya/Banská Bystrica, Fülek/Fiľakovo and Csábrág/Čabrad' in Slovakia; Salgó, Eger and Szécsény in Hungary) using polarizing microscopy, X-ray diffraction, electron microprobe, ICP-OES and ICP-MS analyses to determine the raw materials and production techniques used. Based on the petrographic characteristics, phase and chemical composition of the ceramic body as well as the microstructure and chemical composition of the glazes the tiles can be classified into four main groups. Tiles from the Hungarian sites and Fülek/Fiľakovo – apart from one tile from Eger – are comprised of similar ceramic body including various mineral particles and granitoid rock fragments). The body is covered with high lead glaze (50-70 wt% PbO), mostly green glaze coloured with copper. On some tiles yellow glaze coloured with iron colorant or lead antimonate pigment was used. However, the chemical composition of the ceramic body of the tiles from Hungary and Fülek/Fiľakovo are differ from each other. By contrast, the ceramic body of the stove tiles from Besztercebánya/Banská Bystrica contain variable rock fragments (granitoid, quartzite, micritic limestone). Their green glaze also show unique characteristic: lead antimonate crystals appear sparsely in the copper-bearing glaze. Tiles from Csábrág/Čabrad' form an independent group due to the presence of large amount of volcanic rock fragments with strong hydrothermal alterations in the ceramic body as well as tin oxide opacifier in the glaze. contact and exchange that linked Tintagel with the Atlantic Seaboard and Mediterranean in Late Antiquity. This paper will present the sampling strategy and preliminary results of the petrographic analysis of the main types of transport amphorae recovered at Tintagel.

17

Late Roman Cooking Wares from the Roman Villa of Torre Llauder (Barcelona, Spain): Archaeometric Characterisation

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Torre Llauder is a Roman villa located next to the city of Iluro (Mataró, Barcelona). In Late Antiquity, the villa was transformed, with a reduction of the dwelling area and an increase of productive and storage areas. To investigate the composition, technology and provenance of the Late Roman Cooking Wares (hereafter LRCW) used in this particular site between the 6th and the 7th centuries AD, a total of 47 samples were selected including mainly cooking pots followed by casseroles. Some samples of common wares, including mortars, basins and lids as well as some storage vessel, were added to the sampling to complete the general vision of the daily pottery that could have been used in the kitchen area. It is worth noting that the study of this pottery assemblage from a Roman villa in the hinterland of Iluro was developed within the framework of a wider project investigating the production, distribution and consumption of LRCW at a regional level in Catalonia. The archaeometric study of these ceramics has been

performed through WD-XRF for the chemical characterisation, XRD for the identification of the main crystalline phases, mineralogy, and optical microscopy by thin section analysis for the petrographic characterisation. The results show that the samples share strong similarities both in chemical composition and petrographic features. The petrographic analysis reveals a large granitic group (n=40) that includes four sub-groups. Due to their strong similarities, the different sub-fabrics were discriminated following rather textural parameters and differences in the proportion of certain mineral phases than in general composition. The comparison of the pottery composition with the geology of the area supports the hypothesis of a regional origin for the fabrics defined. The clays used for the vast majority of cooking wares could probably derive from common granitic layers in the area of Maresme, and in particular probably from the granodioritic batholith.

18

Local and foreign features in ceramic products in an Ishmaelite community in Hungary from the 12-13th century. Comparing petrographic and pXRF results

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In this study sixty-two jugs were analysed with handheld portable X-ray fluorescence spectroscopy (pXRF) and in thin section petrography which were compared with fifty assumedly local vessels (cauldrons, storage vessels, pots, and bowls). Jugs are peculiar objects and very rare in 12-13th century Hungary, but they are common at Orosháza. Historical sources give account on Ishmaelite communities, who by serving the Hungarian king played an important role in trading and money exchange in the 12 and 13th centuries. It is very possible that the increased number of jugs at this site may be the result of the religious activities of Ishmaelites. Since jugs are very rare in this period in order to be able to compare them with local technological traditions we wanted to gain as much information on their raw materials as possible, including choices in raw materials, tempers and raw material preparation. Petrographic and pXRF analyses show that the analysed vessels represent eight clearly distinguishable fabric groups. Nevertheless, there is only one fabric group (Fabric 1) which shows only jugs and no other products could be associated with this fabric. These jugs were made from a so-called white clay, which was not available locally. These jugs were clearly made elsewhere, however, the provenance of this clay is yet to be established. In the other fabrics the raw materials and tempering practices of jugs seem to be very similar to those of local vessel types. The results suggest that local potters may have started to change their ceramic production and introduced a new vessel type demanded by Ishmaelite communities. Our analyses offer a vivid and dynamic picture on changes in ceramic technological practices and offers a better and more complex understanding on the social relationships between communities of different religions in Early Medieval Hungary.

19

Mobility in the Neolithic of Northern Greece: Case studies based on Pottery from Central and Western Macedonia, Greece

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This paper reports aspects of mobility in the Neolithic of Northern Greece. Based on the characterisation of pots by petrography, the discussion focuses on the movement of pots and potters by estimating proxies such as the distance of the raw materials and the presence of the finished products in the network of sites. The first part of the paper discusses previous approaches to mobility in Neolithic Greece, while the second is devoted to the results of our extensive research in central and western Macedonia, Greece. For the first time in this region, it is possible to reconstruct the web of mobility systematically by applying large-scale petrographic analysis on a representative sample taken from nearly all the excavated key-sites. Results so far show a degree of mobility in all phases of the Neolithic extending to variable distances, from a modest network in the Early Neolithic, leading up to an extensive and active circulation during the Late Neolithic. In that period, specific categories of pots are located at great distances and potting technology spread widely, resulting in higher uniformity of ceramic products. Mostly traceable in specific ceramic recipes and similarities of ceramic style and technology, this widening access to material culture results in the increasingly unified socialised landscape characteristic of the Later Neolithic communities.

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Mobility of Aeginetan potters around 1200 BC: a science-based archaeological approach

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This paper will present the results of a project entitled TRACT (TRAVelling Ceramic Technologies as markers of human mobility in the Aegean), funded through Marie Skłodowska-Curie Actions, which aims to demonstrate that the informed and interdisciplinary study of ancient pottery can shed new light on past human mobility. Our focus is on potters from the island of Aegina (Saronic Gulf, Greece), and their mobility along the Euboean Gulf, a convenient water passage to the north, towards the end of the Late Bronze Age (ca. 1200 BC). In the first stage of this project, detailed macroscopic comparison of cooking pottery produced on the island of Aegina with similar vessels found at several sites along the Euboean Gulf led to the identification of craftspeople mobility. Subsequent incorporation of ceramic petrology and elemental analysis of both ancient ceramic and geological samples helped in establishing probable provenance and shed more light on the technological choices of potters. In particular, we are able to demonstrate that such pottery has been produced in multiple locations along the

entire Euboean Gulf, and was subjected to limited exchange. Moreover, those locations were not stable through time, as new fabrics appear at a later stage of the studied phenomenon. Comparison between fabrics of cooking pots manufactured in Aeginetan tradition with other locally produced cooking pots highlights on the one hand some differences in the type of raw materials selected, on the other consistency in this respect among Aeginetan potters irrespective of their area of activity. Despite a wide distribution of that phenomenon, it is relatively short-lived, as cooking pottery made in Aeginetan tradition disappears after no more than two generations.

PROVENANCE AND NETWORKS

20 **B** Navigating Spanish Colonialism: The Relationship Between Colonial and Indigenous Ceramics at Santa Fe la Vieja (1573-1660), Argentina

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Santa Fe la Vieja (1573-1660), in the Rio de la Plata River basin in Argentina, was a Spanish colonial town which served as a stopping off point for trade routes via the Quiloazas River (present day San Javier). Discovered in 1949, it hosts a diverse range of ceramics, including indigenous wares, hispano-indigenous wares, colonial pottery, and European imports. Presently, Santa Fe la Vieja is one of the sites studied as part of the ‘Tecnolonial’¹ project which aims to understand technological impact in the colonial ‘New World’, particularly in relation to the expansion of the Crown of Castille (Seville). The diverse assemblage is being investigated by the analysis of 55 samples, chosen on the basis of a detailed typological ceramic study. These include Guaraní indigenous wares, Goya-Malibrigo indigenous wares, hispano-indigenous ceramics, locally produced colonial pottery, Andes Range colonial transport vessels, Seville majolica and olive jars, Portuguese majolica, and Panamanian majolica. The study is focused on the relationship between the indigenous, hispano-indigenous, and colonial wares found at Santa Fe la Vieja using optical microscopy and chemical analysis through XRF. The colonial-indigenous relationship is evaluated from a primarily technological standpoint, examining raw material choice and manipulation, including traditions of temper, forming methods and firing conditions. Quite distinct ‘ways of doing’ in pottery production are identified, with both continuity and disruption evident in the locally produced pottery. In terms of provenance, the indigenous ceramics found at Santa Fe la Vieja show a complex picture. Of special interest are a set of transport jars with distinctly high sodium levels which may be characteristic of

the Andes Range, possibly Mendoza. These are important for our understanding of colonial relationships, and the nature of inter-colonial trade networks between Santa Fe la Vieja and Mendoza. Building on the XRF data, petrography was employed to clarify the range of transport jar fabrics which be imported. On the basis of both petrography and XRF, it is suggested that caution should be exercised in using the established vessel typologies, which may be misleading in terms of the provenance of such transport jars at Santa Fe la Vieja. Finally, these same methods of analysis are used on the European imports in order to investigate their similarities to Sevillian imports from the same time period, and to highlight further the Spanish relationship with Argentina. This integration of petrography and chemistry allows important insights into not only the impact that Spanish colonial ceramic traditions had on indigenous ceramic making processes, but equally the impact that indigenous traditions had on colonial methods. ¹ This research is included in the project Tecnolonial -Technological impact in the colonial New World. Cultural change in pottery archaeology and archaeometry (HAR2016-75312-P) funded by the Agencia Estatal de Investigación (AEI) (Spain) and the European Regional Development Fund (ERDF).

21 Petrographic analysis of Roman coarse and cooking pottery from East of the Theater at Corinth

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The focus of this research is Roman coarse and cooking pottery found during the excavations East of the Theater at Corinth carried out from 1981 to 1990. The examined assemblage ranges in date from the Augustan period to the 5th century CE and includes both imported and local amphorae, basins, pitchers, and stewpots. The research aims to provide systematic compositional and technological characterization of this pottery in order to investigate its provenance and reconstruct potters’ choices at the various stages of manufacture, from the selection of the raw materials through to firing, as well as examine how they were changing through time. The assemblage has been studied macroscopically and 120 samples were selected for laboratory analysis including refring tests and this section petrography. This paper presents the result of this research and its contribution to the studies of production and consumption of coarse and cooking pottery in Corinth.

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Petrographic analysis on Bell Beaker and local Chalcolithic ceramic from Valencina de la Concepción (Seville, Spain): preliminary results and archaeological interpretation

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From around 2750/2500 to 2200/2000 BCE, a distinct ceramic type, known as Bell Beaker, spread in a vast area in western and central Europe. The nature and the driving force of this expansion are a matter of long-standing debate. Previous archaeometric studies revealed that the large majority of Bell Beaker pottery in western Europe were produced from local clay sources. Compositional variations in site level was also recognized. In this study, we will report the results of petrographic analysis of Bell Beaker pottery (n=40) and local Chalcolithic vessels (n=51) recovered from Valencina de la Concepción, one of the most important sites in the south of the Iberian Peninsula, located in the lower Guadalquivir valley in Seville (Spain). In addition, we also collected clay samples (n=16) from the vicinity of the site in order to establish a reference group for comparison with ceramic samples. The aim of the study is to recover information on the raw materials source of both ceramic groups, exploitation strategies of raw material and production techniques.

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Petrographic investigation of early medieval pottery from the Erlauf Valley (Austria)

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The integration of scientific methods in ceramic research is a powerful way to obtain crucial information about pottery production and distribution as well as contributing to the reconstruction of economic and social networks. This applies even in the case of ceramic finds of those areas and periods which have no elaborated pottery classification or detailed historical record. This poster is a case study about how ceramic petrography is able to answer questions related to economy and society in early medieval Lower Austria. Central to the research is petrographic thin section analysis of c. 100 pottery samples from the valley of the River Erlauf. The analysis of this ceramic assemblage has provided valuable information about the origin of raw materials, production technology, degree of standardisation of production, complexity

and networks of workshops as well as trade connections. As the Valley is located between two distinct geological units, the Bohemian Massif to the north (consisting of metamorphic and igneous rocks) and the Eastern Alps to the south (including mainly calcareous (meta)sedimentary rocks), the sourcing of raw materials is very promising in this geologically remarkably diverse area. The investigated ceramic material represents a varied collection derived from twelve archaeological sites of the Erlauf Valley involving both settlements and cemeteries and are dated from the 5th to the 11th centuries AD. Therefore, these ceramic fragments allow the detection of changes in pottery production and distribution over the longue durée in an area which is poor in historical sources detailing the economic and social setup of the period in question.

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Pottery Production and Distribution in W. Greece : an interpretation using pEDXRF analysis

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The scope of the present research is to demonstrate the effectiveness of chemical analysis by using a portable energy-dispersive X-ray fluorescence equipment at investigating the geochemical discriminations in ceramic sherds unearthed at two important archaeological sites in western Greece (Ancient Stratos, Ancient Olympia). This is the first time where a large number of sherds (over 1000) have been analyzed in a overregional perspective in order to elucidate the pottery distribution network from Early Iron Age up to Hellenistic times in western Greece. In Ancient Stratos, the archaeological data assume a local pottery production. The majority of sherds have local origin as the pEDXRF analysis indicates without highlighting differences in raw materials used from EIA up to Hellenistic times. The only chemical discriminations refer to distinctive ceramic fabric (e.g. fineware, cooking ware, handmade) elucidating three raw material sources used for the pottery production showing the technical style of the potters. Ceramic research in Olympia has a long history and the results have become important reference works. The archaeological interpretation identified local ceramics as well as ceramics imports. The most important result of the chemical analysis in selected samples representative of all different interpreted origins, is that many sherds, classified as imported based on archaeological criteria (e.g. Corinthian wares), suggest their local origin. The geochemical data of both archaeological sites were compared each other and the results were impressive. Strongly discrimination could not be obtained between the local pottery of both sites for the majority of trace elements, only the concentration of Yttrium (Y) can provide a more clear separation even if their groups intersect.

Production and provenance of Late Islamic Gulf wares unearthed in the Old Doha Excavations

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In this paper a science-based study of ceramic wares discovered in the excavations of Old Doha is presented. The Old Doha excavations by Qatar Museums and UCL Qatar discovered a stratigraphic sequence running from the earliest occupation in Doha in the early nineteenth century to the most recent archaeological levels. A strategic selection of ceramic wares from this sequence was studied to shed light on the technological background and the provenance of the pottery consumed in Doha between the late nineteenth and the mid-twentieth centuries and by extension the position of the town in the ceramic exchange networks of the period. In addition, as this study is the first of its kind for assemblages from this period and region, it has allowed an assessment of the success in identifying and defining wares macroscopically in Gulf ceramics. The analyses included petrographic and chemical (WDXRF) characterisation of the ceramic fabrics, as well as micro-analyses (SEM-EDS) and characterisation of glazes, on the two glazed wares. Several technological traditions were identified in both the ceramic and the glaze production, while a preliminary assessment of provenance points to potential sources in different parts of modern day Oman, Bahrain, and Lower Iraq. The comparison of the scientifically proposed fabric groups with the macroscopically identified wares, shows variable success in matching, with only some types successfully distinguished macroscopically. The present study will thus have a significant impact in classification and identification of Late Islamic Gulf wares.

Production and Provenance of the Glazed Islamic Pottery from Takht-i Suleyman

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The archaeological site Takht-i Suleyman is located on a calcareous sinter plateau in the highlands of northwest Iran. Historic texts associate the place with the Sasanian fire sanctuary and royal pilgrimage site Azar Goshnasp (until the 7th century CE) as well as with the summer palace of the Mongol ruler Abaqa Khan (13th century CE). Research activities of the German Archaeological Institute (DAI, 1959 until 1977) show that the plateau was intermittently settled during Achaemenid and from Sasanian to Islamic periods (15th century CE). The Museum for Islamic Art in Berlin houses numerous finds from the excavation. The PhD project focuses on the glazed pottery, nearly complete vessels and mostly diagnostic sherds, from the Islamic period (7th century until 15th century CE) and examines typology, technology, pro-

duction and provenance. Kiln furniture is also part of the collection and indicates, along with archaeological findings of kilns, a local pottery production at Takht-i Suleyman. The identification of a geochemical fingerprint is expected to substantiate this hypothesis. Based on the typology and macroscopic fabric classification the fabrics of representative vessel fragments and the fabrics of the kiln furniture are analyzed with MGR-analysis (Matrix Grouping by Re-Firing), WD-XRF and microscopic petrography. The combined analytical approach allows the discrimination between various fabric provenances and the determination of a geochemical fingerprint. The compositions of characteristic glazes are chemically analyzed with ED-XRF to further define the regional material culture. Cross-sections are examined to study technical aspects of the production. The archaeometric identification of a local production at Takht-i Suleyman combined with the comprehensive data collection allows for supra-regional comparisons and research about trade routes and technology transfer.

Provenance and Technology of the Early Roman cooking ware pottery from Nea Paphos

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The focus of this research is the Early Roman cooking ware pottery from different houses of Maloutena, the residential district of Nea Paphos on Cyprus, excavated by the Polish Archaeology Mission of Warsaw University. More specifically, the analysed pottery was unearthed in the Early Roman layers of the 'Hellenistic' House, as well as below the Villa of Theseus and the House of Aion. A detailed systematic macroscopic examination of this pottery, focusing on typology and fabric, identified a number of macroscopic groups, likely reflecting various production centers located both on Cyprus and outside of the island. A total of 79 samples representing the observed variability of the assemblage were analysed through a combined methodology, including refiring tests, thin section petrography and wavelength dispersive X-ray fluorescence spectrometry. The research aimed at providing information on the likely sources of the cooking pots used by the inhabitants of Nea Paphos, as well as contributing to the reconstruction of the chaînes opératoires involved in their manufacture and, consequently, their association with certain potting traditions. As this study forms part of broader research on pottery production and supply at Nea Paphos, it aims at investigating the role of cooking pots in the local pottery production, in the context of wider transformations concerning production and circulation of specialized ceramic types across an emerging Empire. Moreover, it will contribute to the growing understanding of changes in consumer preferences during a period of intense sociopolitical transformations across the Mediterranean and beyond.

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Provenance identification of the high-fired glazed wares excavated from the Late Jin Dynasty (Dong Xia State) sites in Russia's Primorye Region

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This study is devoted to high-fired glazed artifacts excavated from the Late Jin dynasty (Dong Xia) Sites in Russia's Primorye Region. The Jin dynasty lasted for 120 years (1115-1234 AD) and was founded by Jurchen people. Russia's Primorye region of today was once under the jurisdiction of "Xupinglu", an administrative division of the Jin Dynasty. From 1215 to 1233, this region was controlled by the Dong Xia, a short-lived kingdom established in today's Northeast China by Jurchen warlord Puxian Wannu in 1215 during the Mongol conquest of the Jin dynasty. Over 30 mountain walled towns, including Krasny Yar, Shaiga, Anan'evka etc, make up the main body of the relic sites of Russia's Primorye region. The high-fired glazed wares excavated from these sites shed new light on people's lives in "Xupinglu" and the Dong Xia and the commercial and cultural exchanges with the inland regions of China. In this study, according to the archaeological excavations of the Dong Xia Sites conducted in 1972-2015, twenty three pieces and four types of ceramic specimens were studied. In addition to visual observation, the energy dispersive X-ray fluorescence (EDXRF) and field emission scanning electron microscopy (FESEM) techniques were applied to analyze the chemical composition and microstructure of the specimens. The main emphasis was placed on the determination of provenance of white and celadon wares. Seven excavated fine white ware specimens were confirmed as the products by the Ding Kiln in the Jin Dynasty, and nine specimens as Jun Kiln series ware. The most important discovery was two specimens with celadon opaque glaze, which were confirmed as Ru Kiln ware. This finding implies the first discovery of Ru Kiln ware from the Dong Xia sites in Russia's Primorye region. This research is an interdisciplinary cooperation in the technical medieval archaeology of the Far East.

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Raw material and pottery production in the prehistory of Barcelona through the clay provenance studies at Filmoteca site (Northeast of the Iberian Peninsula)

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This poster aims to identify, characterize and understand raw material strategies developed by prehistoric societies in the Pla de Barcelona (northeast of the Iberian Peninsula). To achieve this objective, a petrographic study and DRX results sampled from different pottery assemblages recovered at Espalter Street, also known as the Filmoteca, will be presented. Through a macroscopic and a DRX study of the ceramic set, petrographic groups have been established, which analysed with thin sections, have allowed to make a first comparison, observing the different manufacturing strategies from the same site between different periods. The possibility of studying a ceramic set from one of the highest concentration of prehistoric points in Barcelona city becomes essential to characterize the strategies of prehistoric populations. More specifically, the long sequence of Espalter Street will allow addressing this problematic on a diachronic level. In two very specific moments, such as the Neolithic medium and the initial bronze. Periods well known for its richness in ceramic production across Western Europe.

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Roman- Late Roman wares from surface research in Sphakia area, Crete: An Archaeometric evaluation

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Sphakia is a diverse and mountainous region in SW Crete, Greece. The present study deals with the archaeometric characterization of the Roman-Late Roman ceramic assemblage collected during the archaeological surface survey undertaken in the 1980s and 1990s by Drs J. Moody and L. Nixon. The ceramic shapes recognized include fine drinking and serving vessels such as kantharoi, skyphoi, hydriae, bowls, cups, dishes, plates, transport vessels mainly amphorae, and some domestic vessels (mainly beehives). Our main aim was to identify the Cretan production against potential imports from off-Cretan centers and local imitations of foreign prototypes. For this reason a total of 101 ceramic sherds were analyzed through mineralogical (X-ray powder Diffraction - XRPD; Optical microscopy - OM), petrographic (OM), and microstructural (Scanning Electron Microscopy - SEM) techniques. In spite of their qualitative similarities in terms of their content in aplastic inclusions, the textural differences observed through OM helped us identify nine petrographic groups and seven loners. Moreover, the compositional analysis of the clay pastes helped us distinguish between calcareous and non calcareous groups, and investigate further the technological parameters of this assemblage, namely the clay recipes and firing temperatures. The study and analysis of the material offers an in-depth investigation of the pottery that was produced in or reached this remote part of Crete in an era of intense circulation and sea trade in the Mediterranean. Moreover, it shows the potential of the interdisciplinary approach in a challenging pottery assemblage like the one from Sphakia deriving from surface survey.

Sevillian ceramic exportation to America during the 16th and 17th centuries: new approaches through chemical data

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During the 16th century, Seville became one of the main economics European centres because of the enormous supplies, including pottery, sent to the new Spanish territories in America. Since 1503, the city was chosen to host the Casa de Contratación, a central trading house responsible for the intended monopoly that should control all relations with the new territories. For this reason, the American archaeological and archaeometrical studies have assumed that most of the ceramics, in particular majolica, found on American archaeological sites had been manufactured at Seville, lacking enough empirical data. In order to tackle this issue, within the frame of Tecnonolonia research project a wide program of archaeometric characterization of majolica, glazed coarse ware and transport jars from Seville (16th-17th centuries) was undertaken. A total of 392 samples from this production centre have been compared to 718 samples recovered at the Canary Islands, Colombia, Argentina, United States and the Caribbean. All the samples were analysed by means of X-ray fluorescence and X-ray diffraction. The results highlight that Seville played an important role on the exportation of ceramics to America, mainly transport jars, whilst majolica stayed at the Canary Islands. Finally, glazed coarse ware was mainly distributed locally.

Shades of black: production technology of the black slip ware from Barikot, north-western Pakistan

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The archaeometric analysis of a set of potsherds of black slip ware found at the site of Barikot (Swat Valley, north-western Pakistan), dated between the Indo/Greek and the Kushans phases (middle 2nd century BCE - end 1st century CE), was addressed to define the provenance of this pottery and to constrain the production technology of both the ceramic body and the black external slip in terms of raw materials used and firing conditions. A multidisciplinary approach, consisting in the petrographic, mineralogical, chemical and spectroscopic (Mössbauer) analyses was used to define possible differences between sherds archaeologically classified as grey ware, northern black polished ware and black gloss ware. The composition of this ceramic class resulted quite homogeneous, with indicating the use of similar clay materi-

als (low-calcium and both potassium- and iron-rich) and preparation procedures, especially in terms of clay levigation. When samples are considered in diachronic terms, a progressive, although not drastic, change can be observed among them. The petrographic nature medium and fine sand-sized inclusions indicates that the pottery was produced within the region and possibly in Barikot. As for its production technology, the mineralogical associations indicate that the firing temperature was in the thermal interval between 700°C and 950°C, and the presence of spinel and magnetite that the firing was in reducing conditions. Important differences were observed in terms of paste and slip preparation for the black gloss ware with respect to the grey and northern black polished ware.

The Protohistoric Lower Guadalquivir region in the light of laboratory ceramic studies

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The main aim of the paper is to present the primary results of an ongoing project on ceramic production and its use in the Lower Guadalquivir region known as the ancient land of Tartessos. The scale of the shift of ceramic production in both the Late Bronze and Early Iron Ages, which has its origin dating back to the Phoenician colonization of Iberian Peninsula, is expected to be identified in the project. What is known today about the pottery production and its distribution in ancient Tartessos is limited. Thanks to previous studies, it was possible to establish at least three groups of wheel-thrown pottery according to their chemical composition and possible provenance. 150 ceramic samples from ten archaeological sites of western Andalusia have been examined in our current research. The methodology is based on multidisciplinary analysis, primarily thin-section petrography, XRF and organic residue analysis. The application of up-to-date methods such as organic residue analyses opens up new lines of inquiry which are helpful to discover the organic substances absorbed by the walls of vessels and thus determine the type of foodstuff which they may have contained. Petrographic and spectrometric techniques enable to reveal important details of ceramic technology, like paste preparation, forming, firing etc., and usage i.e. issues of provenance, networks of trade, daily use, deposition and, as a consequence, to identify the changes in ceramic production at the turn of the ages. This research reveals that the use of wheel-thrown pottery in Tartessos at the beginning of Early Iron Age had different social meaning across time and space.

Thermal analysis as a valuable tool to characterize Large Storage Vessels Technology

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The paper presents results from the investigation of large storage vessels (Pithoi) from the Early Helladic settlement of Helike, Achaia, in the NW Peloponnese, Greece. Beyond describing the conspicuously standardized morphological qualities in terms of building techniques that pertain to these vessels, we have carried out detailed petrography, scanning electron microscopy (SEM), X-ray powder diffraction (XRPD) and thermal analysis (TG-DTG). Petrographic analysis revealed evidence of tempering and of low firing temperature. Similarly the examination of the microstructure of the studied material by means of SEM, coupled by the mineralogical determination employing XRPD further supported a low firing regime. In fact, the presence of minerals such as: calcite, illite and vermiculite and/or the coexistence of mixed-layer clays, indicate that the firing temperature could not exceed ~750°C. TG-DTG curves enabled us to detect certain characteristics which are observed among the constituents of a ceramic sample (i.e. clay minerals, carbonates etc.) over a wide range (300-1050°C). High mass-loss was demonstrated in all the studied samples pointing to a temperature of ~690-700°C. This is attributed to the dehydration and dehydroxylation of the clay minerals and the decomposition of calcite. The combination of thermal analysis and XRPD; the latter for the minerals recognition and the former for the thermal behavior of minerals, led us to establish more precisely the choices of potters in Helike concerning the firing of the large storage vessels.

Towards a better understanding of handmade burnished pottery in Late Bronze Age Greece

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Handmade and burnished pottery appearing around 1200 BC at several sites within the Aegean represents an odd element in local pottery assemblages dominated by wheelmade pottery executed in much finer pastes. Therefore it comes as no surprise that such pottery has attracted a considerable scholarly debate, fueled by the fact that its appearance coincides with major socio-political transformations in the wider area of Eastern Mediterranean. However, as it has been argued on several occasions, handmade and burnished pottery represents all but a homogenous group. At least 4 various groups can be differentiated within this large 'family', with most likely quite different origins and courses of development. The best known – and also understood – of those groups is called Handmade Burnished Ware with clear typological and technological links to the Southern Italian peninsula. To complicate the matters further, some of these groups can co-exist at the same site, even in the same deposits. We would like to

argue that in order to understand such pottery, one should apply a bottom-up approach, and look at each site individually before arriving at more general and overarching conclusions. In order to put this postulate in action, we have analysed archaeologically and petrographically a group of handmade and burnished pottery from the site of Pefkakia (Thessaly, Central Greece). It consists of exclusively wide-mouthed strap-handled jars equipped with simple bases that might sometimes be slightly rounded. Most interestingly, petrographic analysis has shown that not only were the fabrics extremely coarse and poorly sorted, but also that they are of non-local origin, with sources sometimes very difficult to pinpoint, clearly beyond the limits of our geological sampling performed in the region. This is in great contrast to Handmade Burnished Ware, which in vast majority of cases proved to be locally produced. The hypothesis we would like to advance to explain such pottery is that we might be dealing with products of non-sedentary populations with a considerable radius of activity covering various geological formations. Moreover, poor quality of fabrics might be explained by their limited pottery production skills, since they would normally be using containers made of organic materials, like skin or wood.

Typologies and Archaeometry in Buthrotum/ Butrint (Albania) from the Hellenistic period to Late Antiquity: Archaeometrical analyses of amphorae and plain utilitarian wares

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Located in ancient northern Epirus (Epirus Vetus), opposite the island of Corfu, Hellenistic Buthrotum, refounded by Augustus as the Roman colony of Buthrotum, has been the subject of extensive excavations. Work on the Hellenistic to Late Antique pottery of the site from excavations by the Anglo-Albanian team since 1999 concentrated on four sites: the so-called Triconch Palace and Merchant's House and the Forum (West) in the city, the large domus and mausolea in the centuriated Vrina Plain opposite and the villa of Diaporit just to the north on Lake Butrint. The ceramic sequences of this important site offer major insight into Adriatic and long-distance Mediterranean trade. With the aid of a Butrint Foundation grant, essential archaeometrical thin-section and chemical analyses of c. 250 carefully chosen samples have been able to answer many questions regarding the origins of some of the key local and imported products of the site. Particularly problematical and the special target of the chemical analyses, has been the wide range of fine, buff amphorae and plain wares (i.e. kitchen and utilitarian wares not placed on the fire, such as jugs, basins, bowls, chamber pots), as the fabrics and typological parallels could indicate various local Epirote sources, as well as possible sources in Corfu, Apulia and even eastern Crete. The chemical analyses have not only defined a large reference group for what must be local-close regional products, particularly for the 3rd century, but also defined as separate (but perhaps not so distant) imports of three major amphora classes of 3rd-4th century (the Zemer 57 amphora), 5th-6th century (small imitations of LRA 2) and 6th century date (a late Roman-early Medieval 'Apulian' type), with major socio-economic implications. These observations, in fact, mirror the conclusions on the same ceramics by the petrology.

Understanding the role of Çeşme – Bağlararası in Aegean and Anatolian networks during the 2nd mil. BC: the case of Minoanising pottery

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Çeşme – Bağlararası is a Bronze Age settlement in central western Anatolia, on the coast of eastern Aegean, facing the island of Chios. The site was inhabited from the middle of the 3rd millennium until the 14th century BC, with important gaps in its habitation history. The ongoing study of the site's stratigraphy, architectural plan and the recovered material culture have started shedding new light on the interface of two worlds, the Aegean and Anatolia, during a period of intense interaction and dramatic socio-political transformations. The material culture of the 3rd millennium BC settlement (CB 3) reflects a local character. Following a long gap, the 2nd millennium BC settlement (CB 2c-a) has so far yielded three successive phases of habitation, disturbed by a severe earthquake marking the division between CB 2b and CB 2a. During this period, the settlement has a western Anatolian character with limited maritime connections and contacts with the rest of the Aegean world. The following CB 1 phase is associated with a large number of pits all around the excavated areas. The cultural material unearthed in these pits reflects a totally different character with strong Minoanizing elements revealing the transformation of the site's role and connections during this period. The current paper aims to investigate this new character and connections of the site, focusing on a category of pottery that makes its appearance for the first time during this phase, the so called Minoanising. It will present the preliminary results of the macroscopic, stylistic and technological study and petrographic analysis of the 'Minoanising' pottery, investigating its sources, reconstructing a number of distinct chaînes opératoires and shedding light on the role of the site in phenomena of hybridisation of different local and regional potting technologies.

Who built the Dolmen? The contribution of Ceramic Provenance Study to the understanding of the 3RD Millenium Megalithic Cemetery of Petit-Chasseur (Sion, Western Switzerland)

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The megalithic cemetery of Petit-Chasseur (Sion, Western Switzerland) is one of the most important prehistoric funerary contexts of Central Europe. The site has been used throughout the Final Neolithic (2800-2450 BC), the Bell Beaker period (2450-2200 BC), and early Bronze Age (2200-1600 BC). The study and classification of the pottery played a key role in defining the cultural identity of prehistoric communities, but, as of yet, did not allow to establish a link with the known settlement sites. In this contribution, we present the results of the multi-element chemical analysis of both Petit-Chasseur pottery and geological materials. Sediment samples were collected from different areas of the Upper Rhône valley, putting an accent to the locations in the vicinity of the known settlement sites. Raw geochemical data obtained by means of the Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Laser Ablation ICP-MS were subjected to multivariate statistical techniques including the Principal Component Analysis and Linear Discriminant Analysis in order to define possible sources of clayey raw materials. The diverse elemental concentration patterns revealed the use of different types of clay sources in the pottery production taking into account not only a diachronic point of view but also a synchronic one. The conclusion thus emerges pointing out the idea of people coming from different parts of the Upper Rhône valley to gather at the site of Petit-Chasseur, which suggests its role as a political and ceremonial center in addition to the burial function it had as a megalithic cemetery. An in-depth ceramic study is therefore proven to be necessary to thoroughly reconstruct the history of the Petit-Chasseur site adding to our understanding of its significance for prehistoric communities.

Wine economy in Picton territory (Western Center of Gaul, IInd century BC – IInd century AD) 1-Archaeometrical study of the containers

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During Roman antiquity, in the western center of Gaul, merchants travelled the Picton territory to sell wine to the local aristocrats established in the area. The large amount of amphorae discovered on many archaeological sites of the region, and dated between the second century BC and the first century AD, is the material proof of these imports. Archaeological studies have shown that these amphorae came from Italy, northeastern Spain, or – to a lesser extent – from the Middle-East. However, regional productions are also attested in Picton territory, as in the workshops of Naintré, Gourgé, Crouzilles-Mougou, Mazières-en-Mauges and Rezé (Laubenheimer et al., 2005, Bertrand et al., 2000 ; Durquety et al., 2012). The locally produced amphorae unearthed in these workshops were made according to some imported forms of containers. More precisely, Picton potters produced imitations of Dressel 2/4 and Pascual 1 amphorae originating from the Tarraconnaise province, and of Gauloises 4 and 5 amphorae from the Narbonnaise province (Durquety et al., 2012b). To better understand to what end these vessels were produced in Picton territory, we undertook to characterize these regional

productions macroscopically, petrographically, and chemically (WDXRF, NMR). We examine amphoric vessels found both in production and consumption contexts to account for the wine economy in the region. The first results should allow us to measure the economic influence of local potters' workshops, to establish the diffusion of locally produced amphorae, and to redraw the trade roads followed by antique merchants. In addition to this work, the implementation of a methodology was undertaken to analyze the composition of organic residues preserved in these amphorae.

APPLIED DECORATIONS

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Analysis of Islamic Glazed Pottery from SW Mallorca (Balearic Islands, Spain)

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In this poster, we analyze the technological features of the glazes of an Islamic ceramic assemblage recovered in the rural archaeological site of Puig de Sa Morisca (Southwest Mallorca, Spain). The archaeometric analysis was carried out on vessels related to a wide range of typologies and origins and also includes the characterization of pottery fabrics by means of thin section optical microscopy. The analysis of the microstructure and the chemical composition of the glazes was carried out through polished resin blocks by means of scanning electron microscope equipped with energy-dispersive spectrometry (SEM-EDS). The archaeometric analysis conducted allowed us to approach the technological choices applied by the local Almohad workshops to produce glazed ceramics at the end of the 12th Century and the beginning of the 13th Century AD. Results show the use of calcareous clays and lead-silica glazes which, in some cases, were opacified with tin, among other technical solutions. Moreover, we confirm the existence of a group of samples that have certain technological particularities within the analyzed record regarding both, their origin and the technology applied in their decoration. These are singular vessels related to tableware typologies and, in most cases, imported fabrics (e.g. metamorphic, igneous) that have also shown a particular chemical composition in their glazes. Finally, it must be highlighted that this is the first time that a ceramic assemblage from Islamic rural contexts from the Balearic Islands has been analyzed using archaeometric methods.

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Asian elements on Meissen porcelain

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Asian elements on Meissen porcelain Meissen is a county in Dresden, Germany. In 1708, the first European mature porcelain was produced in Meissen Castle. In 1710, Meissen established the first royal porcelain factory. Since then, Meissen has become a center for European ceramic production. The formula of Meissen porcelain was first obtained from the French missionary Père Francois Xavier d'Entrecolles. He has been teaching in Jingdezhen (China's porcelain capital) for more than ten years. He has obtained a large number of Jingdezhen porcelain production methods and raw materials. After that, Père Francois Xavier d'Entrecolles sent the formula of Jingdezhen porcelain to a friend in France. Later, the Emperor Augustus received the letters from the French and tested it hundreds of times according to the formula written in the letter. Finally, in 1708, the mature European porcelain was created. In the following decades, Meissen porcelain influenced the production of porcelain in Austria, France, Italy, and the Czech Republic. In the first 20 years of the production of Meissen porcelain, it was deeply influenced by Chinese and Japanese porcelain. For example, the classic onion pattern on Meissen porcelain is transformed from three fruit patterns in Chinese porcelain. The pattern of the characters on the Meissen porcelain is likely to come from the image of the Japanese. Moreover, the porcelain shape in Meissen porcelain has many similarities with traditional Chinese porcelain shapes. The gold color decoration on the Meissen porcelain has a close relationship with the gold color decoration on Japanese porcelain. This article compares the Meissen porcelain with Chinese porcelain and Japanese porcelain, and discovers the Asian elements from the Meissen porcelain, summarizing the connection between Meissen porcelain and Asian culture.

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Decorative production and technical diversity in the III to II millennium cal BC transition on the plain of Barcelona (Spain)

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This poster aims to address the problems regarding the characterization of the ceramic products from the beginning of the Early Bronze Age. To achieve this target the research will consist of a morpho-technological analysis, complemented by the analysis of the decorative patterns, of the ceramic productions of the Early Bronze Age that can be found in different deposits of the Pla de Barcelona (Northeast of the Iberian Peninsula). To carry out this analysis accurately, the research will be mostly focused on the design manufacturing process of the production from 4 archaeological sites (Caserna de Sant Pau, Santa Caterina, Filmoteca, Plaça

de la Gardunya), studying the different manufacturing and processing of the raw material processes until the finished product is reached. As is well known, Incised and impressed decoration is the more distinctive element in epicampaniform production. Barcelona recovered sherds will provide interesting information in a stylistic and chronological view that can help to understand broad Nord-East pottery production during Early Bronze Age period. From said analysis, the current state of ceramics from the Northeast group will be reviewed, followed by the characterization of Epicampaniform ceramics, to be able to verify if this type of ceramic productions can be isolated, to assess their representativeness in a decorative point of view. Finally, from the ceramics it will be possible to infer the communities of practice and the socioeconomic consequences that are derived from their symbolic, aesthetic, use, consumption and amortization.

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Reconstruction of the production technology of Zsolnay ceramic paintings with oil painting effect

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One of the main innovations of the Hungarian Zsolnay ceramic factory established in the mid-19th century was the production of coloured glazed ceramic paintings with oil painting effect. Ten ceramic paintings depicting the portraits of kings and saints of the Árpád dynasty decorated the Saint Stephen Hall in the palace of the Buda Castle from around the turn of the 19th and 20th centuries. However, the series was destroyed during the 2nd World War. The production technology of the ceramic paintings, especially the execution of the portraits, is ambiguous; even contemporary sources are contradictory. In order to reconstruct the material usage and the technology of ceramic paintings, intending to support the elaboration of the technology of replica production, the material of three preserved test paintings was investigated. Preliminary digital microscopy and handheld X-ray fluorescence studies were performed on the glazed surface of the paintings. Small samples detached from the glazed surface of one of the painting (portrait of King Béla IV) were studied by electron microprobe and micro-XRD analyses performed on polished cross sections to reveal the sequence of the layers and to determine their composition and colorants. The ceramic body (“pyrogranite”) was covered with a thin (up to 0.1 mm), white clayey layer, on which a white-coloured tin-opacified lead-alkali glaze (c. 11-20 wt% PbO, 6-7 wt% total alkali, 8-10 wt% Al₂O₃, 15-17 wt% SnO₂) was applied. It was covered by glaze with higher lead and lower alumina content (c. 26-30 wt% PbO, 8-10 wt% total alkali, < 1 wt% Al₂O₃). In the red-coloured areas Ca-Sn silicate pigment particles appear between the upper and lower glaze. For some decorative motives around the portrait the white tin glaze is covered by blue-coloured glaze, then by a very thin gold paint layer. The blue-coloured upper lead glaze contains lots of Co-Zn-Ni aluminate and Zn-Co silicate pigment particles. In addition, lot of newly-formed tabular K-Al silicate crystallites are present on the top of the upper blue glaze and on the boundary of the two glaze layers.

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Renaissance ceramic production in Prague: utility ceramics and luxury goods

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Archaeological ceramic production from Prague consists of utility ceramics, technical ceramics, luxury goods and ceramic building materials which were found during the initial period of archaeological research in the 20s and early 30s of the 20th century in Prague Hradčany (the area of Prague Castle). The collection set of finds contains more than 630 objects of fifteen varied shapes and different processing qualities. The surface was smooth without decoration (e.g. pipkins, pots, stoves) or glazed using inside and later also outside transparent or coloured glazes (e.g. pots, bowls, pipkins, jars) or coated by engobe and subsequently by glaze (e.g. stove tiles) depending on the type of an object and an expected usage. Luxury goods were decorated with several decorative layers. Ceramic bodies, glazes and surface finishings of selected archaeological finds of utility ceramics and luxury goods from Renaissance waste pits were analysed. Mineralogical compositions of ceramics bodies proved that processing technology of ceramic finds were within a wide range depending on the identified crystalline phases. The study of microstructure as well as the results of XRF and XRD analyses proved that the raw materials used throughout the Renaissance period did not significantly change. The majority of analysed glazes did not show any crystalline content. In the glazes of four vessels, cassiterite was identified as opacifier. Corrosion products in the form of sulphides, phosphates and chlorides were identified by XRD on surfaces of most degraded glazes. Micro-Raman spectroscopy was used to study glaze colorants; it proved the presence of Naples yellow in several green glazes. Further, calculations and evaluations of stress relations of glaze - ceramic body systems were performed and followed by the characterization of primary surface defects – especially peeling, crazing, specking, bubble defects, pinholing and blistering. This research has been supported by the grant NAKI II DG18P02OVV028.

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The case of Green and Manganese production from Barcelona between 13th and 14th century: analyzing its production and its decorations

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Green and manganese productions are known to be one of the first majolica manufactures in Barcelona during the end of the medieval period. As an evolution of archaic majolica pottery, green and manganese is considerate as an innovation in producing glazes, entailing different degrees of complexity according to the result: a glaze with a high variety of decorative motifs, made mainly adding manganese and copper as pigments, as well as minerals acting of opacifiers to the glaze, getting a vessel with a green and black decorated glaze. The latest archaeological excavations in different archaeological sites of the city provided more than 1.000 sherds of ceramics decorated in black and green which were produced in Barcelona. Based on that and with the aim to deepen knowledge of GM technique of production, a study has been carried out by means of X-ray fluorescence (XRF), X-ray diffraction (XRD), Scanning Electronic Microscopy (SEM). Throughout this study, we intend to observe whether we can distinguish different chemical groups related to varied workshops in Barcelona, and simultaneously to discern whether the decorative motifs and the ways of producing glazes can be used as an evidence to discriminate crafts, or if different techniques could be related to the purposes of vessels.

46 The tyranny of the obvious: Decorated pottery from Neolithic Dispilio, Greece

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There are relatively limited studies where decorated pottery itself constitutes the object of theoretical inquiry, instead of being treated as the material evidence which supports the approach of more complex concepts such as “art” or “style”. Stemming from the study of the late Neolithic pottery from Dispilio, Northern Greece, this paper proposes a theoretical and methodological approach in an effort to shed light on the social significance of decorated pots while involved in social practices or enmeshed in relationships among pots and producers. In this approach, decorated pots are examined as cultural entities, as specific cultural icons, and not as simple bearers of cultural icons, “abstract” or “representational”. Decorative techniques, patterns, motifs, shapes and technological features of the pots are considered as parameters of a single process, none of them being primary or secondary, critical or restrictive; none of them being cut off from others, leading to more “explicit” evidence for the social meaning of decorated pots. Motifs do not simply decorate clay surfaces but concrete products of the material culture and their significance lies on, precisely, this characteristic: they do not exist by themselves, but they take part in the construction of an artefact. In this line of thought, every decorated pot from Neolithic Dispilio is examined as a structure that is not identical to the simple sum of its parts, but includes the causal relationships of their interconnection. It constructs, in a sense, a “narrative”. Some of these narratives refer to human-like and other animal beings. Following the above proposal, the question that arises, is whether a modern researcher can approach these images-narratives, whether in other words a contemporary narrative can encounter through decorated shards a prehistoric narrative.

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Yellow enamels in Japanese and Chinese porcelain of the late 16th to the 20th centuries – pigments and technology

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The production of porcelain in Japan began in 1610 and decoration with overglaze enamels was introduced ca. 1640. In 2018, Montanari et al.¹ stated that a porcelain plate dating from the Kan’ei period (1624-1644) was made in China and posteriorly enamelled in Japan using the Naples Yellow pigment (lead antimonate) for the yellow colour. The authors argued that the enamelling technology used was distinct from the coeval Chinese technology and concluded that enamelling was made under supervision of western Jesuit missionaries in Japan according to the Italian majolica technology, although, manufacturing and documental evidence indicates that in Japan iron pigments were used for the yellow colour until Meiji Restoration (1868). In order to investigate this topic, a project was started which aims to determine the yellow pigment used in Japanese and Chinese enamels between the 16th and the 20th centuries, and also to investigate this new hypothesis on the introduction of a European enamelling technology in Japan. The methodology includes the analysis of ceramics and the study of historical documents, namely Jesuit archives and books of recipes of local kilns. In this work, the results of non-invasive analysis of Chinese and Japanese yellow enamels and glazes using portable X-ray fluorescence are presented. So far, in the Japanese objects dating from the 17th to 19th centuries iron was the colouring agent used and only in a 20th object a lead based pigment with antimony and tin was detected. In the Chinese objects iron and lead based pigments were identified in objects dating from the 17th to the 20th centuries. ¹ Montanari, R., Alberghina, M. F., Casanova, A., Massa, E., Pelagotti, A., Pelosi, C., . . . Sodo, A. (2018). A polychrome Mukozuke (1624-1644) porcelain offers a new hypothesis on the introduction of European enameling technology in Japan. *Journal of Cultural Heritage*, 32.

CERAMICS AS BUILDING MATERIALS

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Glazes, colourants and decorations of tiles from Schwarzenberg Palace in Prague

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In the area of Prague Castle, intensive rescue archaeological excavations has been taking place since the 1920s. A widespread collection of thousands of vessels and hundreds of thousands of ceramic fragments consists of finds from Early Middle Ages to modern period. An important part of the ceramic collection is formed of decorative tilework and stove tiles from Schwarzenberg Palace. This research was focused on the study of glazed relief decorations of this type of specific Renaissance set of finds. The paper is concentrated on four unique large-format reliefs ceramic tiles from the second half of the 16th century. A crowned heraldic eagle in a square heraldic shield with a split-tailed Czech lion and a barry of eight argent and gules, is presented on the largest rectangular decorative tile (approx. 62 x 55 cm). Other two semi-circular tiles of the diameter approx. 92 cm are also decorated with heraldic symbols. All surface layers were firstly investigated by non-invasive methods (Micro-Raman, portable XRF). It was found that the crown of the lion was gold-plated and other coloured coatings were mainly lead or lead-tin glazes with colourants in the form of dyes (Co, Cu, Fe, Sb, Mn, etc.). The combination of several different colourants had resulted in different shades of green, yellow and blue colour. Chemical and mineralogical compositions of ceramic bodies of stove tiles were also evaluated by invasive methods (Raman spectroscopy, XRF, XRD, thin-sections optical microscopy), which made it possible to compare the results of non-invasive and invasive analyses. This work has been financially supported by the project of the Ministry of Culture Czech Republic DG18P02OVV028 “Technology of Treatment and Identification of Degradation Processes of Ceramic Finds from Hradčany Palaces – Methods of Restoration and Conservation of Porous and Dense Ceramics and Porcelain”.

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Mapping salt contamination of lime plaster at a historic Hakka Mansion using portable Raman spectroscopy

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As one of the most populous regions in the world, Hong Kong is typically associated with sleek skyscrapers contrasted with dense urban housing. However, Hong Kong has a wealth of historic structures ranging from traditional Chinese construction with timber framing and glazed-tile roofs to red-brick colonial buildings. Unfortunately, the subtropical climate of Hong Kong with its high humidity, high temperatures and heavy wind and rain during typhoons rapidly deteriorates poorly maintained or neglected historic structures. The environment is particularly harsh for lime renders and plasters, commonly used at the exterior and interior of a variety of building types. In addition, well-intentioned repairs to lime plaster using cementitious materials contribute to the poor condition of the wall coverings. These improper repairs are not always visible due to additional paint layers, and sampling may not be possible in historic structures. Therefore, a portable Raman spectrometer was employed to non-destructively identify intrusive salts in the plaster and map the extent of salt contamination at a historic Hakka mansion in Hong Kong. Moisture levels of the construction materials and traditional chemical testing strips for identifying salts were also employed to corroborate

the Raman spectroscopy data. Results from this study indicate that portable Raman spectroscopy is a promising technique for qualitatively mapping the extent of salt contamination and can be employed in sensitive areas where sample removal is not permitted. Though the results presented here were conducted only on non-painted surfaces, future research will hopefully be extended to the evaluation of areas beneath paint layers.

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Petrography on a hot ceramic roof. Connecting ceramic building materials with household wares to reconstruct pottery production systems in Archaic Satricum (6th/4th century BC)

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At the easternmost border of Latium Vetus, the Archaic sanctuary of Mater Matuta located on the acropolis of Satricum (60 km south of Rome) served as regional center of ceremonial importance and very likely wielded economic power in the realm of local craft production activities. Three successive temple buildings - each rebuilt on a more monumental scale - and three enormous votive deposits excavated in the area surrounding the religious structures testify to offering practices over a long period of time, spanning from the earliest temple phase (625/500 BC) to the last imposing building (480 BC) and well beyond its decay (3rd/2nd BC). The longstanding research commitment of the University of Amsterdam at Satricum has yielded a wealth of information on the Archaic phases (6th/4th BC) of the settlement, a key period in which many central Italian sites underwent fundamental changes in terms of urban development, social stratification and increased craft production. The latter aspect has been investigated focusing especially on the rich ceramic record unearthed over the years, among which building materials pertaining to the sanctuary have played a major role. However, greater attention has been paid to the architectural terracottas decorating the rooftops of the three successive temple buildings, largely overlooking other more humble heavy clay materials, which may provide equally important evidence in order to trace the scale and intensity of ceramic production. This paper will present the results of the systematic study conducted on consistent bodies of undecorated roof tiles alongside large storage vessels (dolia) and coarse wares, which integrates thin section petrography, statistical analysis and raw materials survey. The data collected will be discussed against the background of extant evidence for ceramic manufacture (kiln sites) in order to depict a more comprehensive picture of pottery making systems at Satricum during the Archaic period.

Raw materials and technological constraints used for the construction of ceramic material at the eastern border of the Roman Empire

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Stamped bricks and tiles were recovered from the remnants of the Roman baths in Târgșoru Vechi, located at approximately 10 km SV of Ploiesti (SE Romania). The baths were built by the Roman soldiers during the Dacian wars, between 101 and 106 A.D. They were used for a short period of time and were abandoned after withdraw of the Roman army in 117 A.D. The bricks and the tiles bear the stamps of the legio I Italica, legio XI Claudia and of an auxiliary unit, the cohorts I Flavia Commagenorum. The ceramic materials were investigated by optical microscopy, X-ray powder diffraction (XRPD) and Fourier-Transform infrared spectroscopy (FTIR) in order to obtain information on composition, thermal changes and technology. For provenance investigation, the bricks and tiles were compositionally compared with clays and marls cropping out in the surroundings of the site. The bricks and tiles have an essentially Fe-rich illitic-muscovitic composition. The matrix ranges from low birefringent to isotropic. The non-plastic grains consist of quartz, muscovite, plagioclase, calcite as well as rare igneous and metamorphic rock fragments. The XRPD shows the characteristic peaks for quartz, illite/muscovite, calcite, feldspar, chlorite and hematite. The 10 Å illite/muscovite peak is diminished or missing in most of the samples suggesting a thermal transformation. The FT-IR data correlates with the XRPD analyses where the main absorption bands are at 3440 cm⁻¹ (band of -OH hydroxyl group, diminished due to firing), 1632 cm⁻¹ (water), 1431 cm⁻¹ (calcite), 1078 cm⁻¹ + 647 cm⁻¹ (feldspar), 795 cm⁻¹ + 778 cm⁻¹ and 693 cm⁻¹ (quartz) and 460 cm⁻¹ (illite/muscovite). The mineralogical composition of the geological samples suggests that the bricks and tiles were produced from Holocene marly clays quarried nearby. As tempering materials, alluvial sands from the Prahova River were probably used. Firing temperature was between 800 and 900°C.

Traditional mortars modified with ceramic admixtures for thermal insulation of historic buildings

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One of the main issues that architects and engineers face today during renovation and conservation of traditional and historic buildings is the enhancement of buildings' energy efficiency, by respecting and sustaining at the same time the authenticity and original context of the structure. In this context, traditional plasters and renders offer a group of very promising solutions, by addressing simultaneously aspects of protection, water and thermal insulation, comfort and promotion of traditional building techniques. Different types of laboratory prepared lime-based renders were studied for their thermal insulation properties. The results were compared to the thermal properties of archaeological ceramics usually mixed in lime mortars. Based on the survey of a wide range of archaeological and traditional mortars and plasters, this work proposes the use of lime-based mortars, modified by porous ceramic fragments and pumice as an effective approach for thermal insulation and protection of traditional and historic buildings. Both are low-cost, porous, durable and reactive materials that were traditionally used for enhancing the performance of lime-based mortars since Roman times. The thermal conductivity of the renders was determined with a stationary guarded hot plate setup, which has been successfully established in the investigation of heat transfer in insulating materials. Besides thermal conductivity, open porosity, mechanical properties and electron microscopy studies were conducted towards a better interpretation of the observed performance differences among the different mixtures. By replacing the conventional aggregates with porous reactive fragments, a significant decrease of thermal conductivity was determined (-70% of the initial values), depending of the granulometry and b/a ratio used in each different mixture. These values can be further reduced by incorporating low-fired ceramics fragments of tailored porosity. The suggested renders encompass all required strength and durability characteristics set by modern building codes, while in addition, offers a cost-effective, compatible group of thermal insulating materials.

"A Second (Lesser?) Life": Secondary uses of Ceramic Artifacts within contexts of the Northern Tyrrhenian Sea Areas (Liguria and Tyrrhenian islands): Archaeological evidence from the Second Iron Age up to the Roman Period

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Secondary uses of ceramic artifacts (not only containers with a different content, pottery used as funerary containers but also pottery used as building materials, e.g.) are attested, in the Northern and Central Tyrrhenian area, both in regions with a lower data frequency like ancient Liguria, and in still less known ones (like Corsica). A first state of the art about secondary uses of pottery artifacts in these areas may be documented, summarizing old and recent data: for instance, the further life of trade-containers involved into secondary uses gives us pieces of information about practices of local 'material cultures' too: how they deal with these artifacts not only for the transported goods, but also how they're assumed within local know-

how frames. The widespread secondary usage of trade-containers may be, in fact, the answer to local, private needs (domestic or funerary and ritual ones, e.g.), but it may also show the more ambitious adoption of 'building' practices, especially in trade-spaces and public ones. The considered area may document pottery involved as building material, both in circumscribed 'privae' spaces (like fireplaces, in Corsica and on some Liguria sites; probable water containers on high-site at Elba island), and in wider employments of shared whenever not 'public' areas (like 'fences' of late-punic amphorae from old finds in the South-Sardinia, or the probable Roman draining layers for a recent find in Liguria). As these data have been scarcely considered in their whole in this area (they usually are dispersed in scattered editions, old and new ones), a preliminary collection is the first aim of this proposed Poster. Upon this base, at a further level of lecture, one will be allowed to investigate the 'empiric' practical applications of these usages, their specific answer to certain landscape features, and their eventual 'semantic' renewal.

ALTERATION AND CONSERVATION

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The conservation and restoration of the Iznik pottery finds from the Sveti Pavao - Mljet shipwreck

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The Venetian merchant ship had completed its journey at the end of the 16th century at the bottom of the sea of the shallows of Sveti Pavao (St. Paul) near the coast of the island of Mljet in the Adriatic sea. Its remains were found in August of 2006. by Scuba Diving Club that immediately informed the Ministry of Culture and the Department of Underwater Archeology of the Croatian Conservation Institute and they organised rescue excavations the following year. Research has been carried out since then, through annual campaigns, to this day. The best preserved and the most numerous part of the ship's cargo is pottery made in the Ottoman town of Iznik, intended for the western market centers such as Dubrovnik, Venice and Genoa. The conservation of these high quality vessels was an extensive and demanding process and it was done in phases. Immediately after their recovery from the sea, the finds were sent for desalinization during which the water in the special tanks was periodically changed with regular measuring of chloride concentration. The artefacts were in different conditions depending of the quality of the ceramic body and glaze and specially the microenvironment they were in at the site. Some of the finds were of high quality ceramic material with a preserved glaze and scarce sedimentary deposits and some were with no glaze at all. The influence of the microenvironment on the damage was the theme of a small research. The damage on the vessels was caused by processes in the sea, sea organisms and the compounds produced by degradation of metal objects. The products of corrosion pierced deep into the damaged glaze and the porous structure of the pottery causing the greatest damage. The largest share in conservation concerned cleaning and consolidating the structure of ceramic material.

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The conservation of Attic vases at the British Museum: changing perspectives

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The conservation of red and black-figured Attic vases from the collection of the British Museum has overtime known many different approaches. While past treatments often involved aesthetic enhancement, conservation of these vases is now primarily aimed at showing the original surface. The surface is no longer overpainted and the amount of restoration material and retouching applied to objects now depends on different aspects, such as stability and display. Damaged areas are left visible, if they do not distract and do not affect the overall stability of the object. For an upcoming exhibition on Troy, different types of Greek vases relevant to the subject were selected for display. The colour of some of the painted fills applied to these objects in the 1980's was found to be substantially different from the colour of the original surface, which distracted the eye. To make the objects look presentable, these old fills needed to be removed and re-applied, using current day methods and materials. All break lines had been filled as well, which was a common practice in the past. Especially in those areas where the alignment of fragments was unsatisfactory, thick layers of filling material had been applied. These covered a large part of the original surface and obscured original incisions and details vital for observing the outlines of the figures depicted. During the removal of old restoration materials, it became apparent that damage from wear was often overpainted, as well as areas that were believed to be intact. All treatment options were discussed by the curator and conservators in order to deal with these issues, as leaving the damage visible was sometimes found to hinder readability. These conversations have led to research and evaluation of past conservation practices of red-figured and black-figured Attic vases in the British Museum collection and has encouraged us to reflect on current conservation practises.

EXPERIMENTAL STUDIES AND ETHNOARCHAEOLOGY

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Identifying wheel-fashioned and wheel-thrown vases in Middle Minoan Crete. Coupling macroscopic analysis and experimental archaeology

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In the last twenty years much work has been done in order to understand the use of the potter's wheel in Minoan Crete, after its introduction in Middle Minoan IB (19th cent. BC). Most of recent studies based on experimental archaeology have explained that the wheel-fashioning technique, i.e. a combination of coil-building with the use of the wheel, has been the only forming technique in use in Minoan Crete, while the wheel-throwing technique was not adopted until the Late Bronze Age or later. These experiments have, however, failed in explaining the forming technique used to produce one the most attested open vases in Middle Minoan II (18th cent. BC) sites of Southern Crete (e.g. Phaistos, Haghia Triada and Kommos), the conical cup, which is only 3-3,5 high and preserves a very small base (3-3,5 cm.). Two are the reasons of this failure: first of all, the experimental archaeologists have reproduced vases using industrial clay, instead of the clay used in Minoan times, which is much less plastic and workable; second, only vases with a base diameter bigger than 4-4,5 cm have been reproduced. In this paper, I want to propose that only coupling macroscopic analysis and the skill of an experimental archaeologist who adopts clays, kits and tools in use in Minoan times, it is possible to identify whether vases were produced through the wheel-fashioning or the wheel-throwing technique.

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B

Investigation on present day Islamic pottery from Fez (Morocco) as a source for analogy on archaeological majolica. Ceramic bodies and glazes

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Decorated glazed tableware is still under everyday production in Morocco, where it is solely produced in towns, not in the countryside. This pottery is referred as Islamic pottery, and it belongs to the tradition of decorated glazed earthenware Islamic and majolica. In that respect, we can assume that their study can be used to shed light on technical aspects of archaeological majolica production. Potters in Fez used to be settled in the potter's quarter within the old town (Medina quarter) of Fes, but from the 1960s onwards they have moved to the Ain Noqbi quarter at the north-east edge of Fes, out of the old town. Similarly, exploited clay beds have changed from the old clay beds, just at the south of the old town, very close to the potter's quarter, to the south-east of the old town, in the area that expands between the Ouislane river, limiting the new town by the east, and the Sebou river at the east. These exploited clays in the area are marls from the Upper Miocene formations that expand in this region from Fez to Meknes and westwards. The workshops of two potters (Rtab and Al Filali) have been studied and raw materials and products (body pastes and glazes) have been chemically characterized by means of X ray fluorescence analysis (XRF), X ray diffraction analysis (XRD) and scanning electron microscopy (SEM-EDX). The results shed light of different aspects of the present-day majolica tradition still alive at Fes.

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Medical applications in favor of pottery recording and data management

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Artefacts are the building blocks of archeology providing insights into life and society. Pottery as the most abundant category is additionally a valuable tool for underlying chronology of archaeological sites. Therefore, interpreting pottery fragments, recording and documenting pottery assemblages is the most important task for an archaeologist. When it comes to pottery and image recording, the light is shed on archaeological illustrations, either as pencil drawings or digital ones, photographs, alongside with feature analysis. Drawing artefacts is a difficult, time-consuming process in need of the human hand and thus it can be subjective and even inaccurate sometimes. On the other hand, photography is more objective, yet it produces only two-dimensional images. Enhancing our abilities, on an experimental basis, we placed emphasis on a non-destructive technique, evolved in the medical field. We hold for comparison, the conventional 2D images of the aforementioned techniques and took advantage of the use of the High-resolution X-ray Computed Tomography (CT). The capacities of medical CT are demonstrated through the elaboration of images of pottery vessels manufactured in different techniques by one of the authors (NK). We achieved a precise, complete and less time consuming profile acquisition with accurate measurements, while we managed to visualize the inner morphology of pottery forms, even of very small or closed shapes. Moreover, we extracted supplementary information for the inter-structure by limitless 3D reconstructed rotatable images able for processing whenever is needed for the research purposes. Could we be informed in a similar way for ancient pottery artefacts? Our next step is to apply on them the same technique, while our expectation is to create new possibilities in recording with the use of the medical CT.

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Understanding the Medieval Ceramic Producing Process with use of Experimental Archaeology

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Wednesday 18 Sep.

Session 02 11.15-12.00

DEVELOPMENT OF NEW METHODS AND TECHNIQUES

1

12 MeV Proton Activation Analysis combined to IBA techniques for compositional studies of various archeological artefacts from Roman and Merovingian sites (Ostia Antica, Artena, Nevers)

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A combination of 3MeV proton PIXE-PIGE, MA-XRF and 10-15 MeV proton activation analysis has been recently applied on the external beam line of the cyclotron of IPNAS/CEA laboratory from the University of Liège, and thus, to a wide variety of archaeological specimens (glass, pottery, mortars and pigments) all provided by on-going studies and excavations of housing materials, wall decorations, and vessels led on two remarkable Roman sites and one Medieval site: First, from an important agricultural complex excavated on an artificial terrace from a republican town, Artena, located, 40 km South-East from Rome, near the Via Latina and the Campania; second, from the Domus dei bucrani, a house dating from the end of the Republican era discovered on the site of the Schola of the Trajan at Ostia Antica and third, from the sixth-century glass mosaic from Saint Etienne church in Nevers, France. The aim of the present work is to explore and report the specific analytical interests of Charge Particle Activation Analysis implemented with protons ranging from 10 to 15 MeV, as a non-invasive analytical technique for the detection of elements with $Z = 11-40$ and beyond, and to address its suitability to solve questions raised by archaeologists. We present in this paper the preliminary results obtained following methodologies reported in recent pioneering and more recent works and emphasize on the achieved sensitivities (Limits of Detections) for elements as Ca, Ti, V, Cr, Fe, Cu, Zn, As, Sr, Y, Zr and Sb ranging from percentage to parts per million (ppm) levels.

3

Ceramics of city Bolgar: first results of NAA researches

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The study of the chemical composition of the medieval ceramics, produced in Bolgar (one of the largest cities in the state of Volga Bulgaria in the X-XIV centuries) began relatively recently. In this case, atomic emission spectral analysis (AEA) was used. Neutron activation analysis (NAA) is able to give much more exact data for a number of elements. During the work, the following standards manufactured at the National Institute of Standards and Technology (NIST), USA were used: 1633C, 1635A, 2431, 2586, 2684C, 2710A, 2782, 50C, 87A. The mass fractions of many elements were determined (Fe, Sn, Na, Cr, Ag, Ba, As, Ni, Sc, Zn, Zr, Yb and others, totally more than 30 elements). On some elements important for studying the composition of clay masses, X-ray fluorescent analysis (XRF) was also additionally involved. As a result, it was found that there are some deviations from the data provided by the AEA, however, these deviations are small and the data from previous works can be used as a comparative material. The stable chemical composition of the clay used by the potters of the medieval Bolgar, and fluctuations in the quantitative composition of the trace elements in these clays were established. There is also an observation that requires verification: in glazed ware the proportion of lead is significantly higher and in white-slip ware there is calcium (in both cases it is not the surface layers, but the core of the sherd). Other deviations in the mass fractions of trace elements, which have not yet received an explanation, are also noted.

4

Combining X-Ray Microdiffraction with Optical Microscopy: Surplus for thin section Petrography of Ancient Materials

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This presentation gives an overview of the advantages of combining thin-section optical petrography with X-ray microdiffractometry equipped with focusing X-ray optics and large 2-dimensional X-ray detectors (×-XRD2) and presents case studies for different types of archaeological artefacts ranging from building materials to pottery. In addition, perspectives for further methodological developments and archaeological applications are presented. Optical thin section petrography is a well-established tool for characterizing the mineral content of ceramics. Along with the identification of minerals, the unique advantage of this technique is the direct insight into the grain size and shape of inclusions and textural features of the ceramic fabric. This information provides important indicators that are useful for answering archaeological questions regarding the provenance and production technology of ancient ceramics. However, optical microscopy does not allow for the identification of opaque phases or minerals smaller than app. 10 ×m. This excludes important ceramic phases like clay minerals, many metal oxides or small mineral phases forming at relatively low temperatures during the firing processes. X-Ray Powder Diffraction can be used to identify these minerals, but requires a certain amount of fine ground material. This can be avoided using ×-XRD2, allowing non-destructive and local highly resolved phase mappings of archaeological artefacts within

a few minutes, even in cases of uneven surfaces. Because no sample preparation is required, a direct local and non-destructive characterization is possible which is essential for studying archaeological artefacts. Such systems are also perfectly suited for local phase mapping in bare thin sections to identify minerals, which could not be characterized by optical microscopy. ×-XRD2 is therefore a powerful tool not only for the combination with optical microscopy, but also with other types of microanalyses such as ×-Raman spectroscopy and ×-XRF for a local, highly resolved, fast, non-destructive and comprehensive characterization of all kinds of archaeological artefacts.

5

Developing a tool to trace shell-tempered ceramics: A case study from the Yazoo Basin (Mississippi, USA)

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The elemental chemistry of ceramic bodies constitutes a powerful sourcing tool that has been used for decades in all parts of the world. In such studies, temper may be treated as “noise,” when in fact it may itself be a useful sourcing agent, especially with shell-tempered ceramics. The main objective of the research project presented here is to develop a method that will allow sourcing shell-tempered ceramics, improving our knowledge about their circulation and exchange. The approach developed here is based on recent pilot studies demonstrating that freshwater mussel shells from archaeological sites from different drainages in the eastern and southeastern United States present different elemental compositions (e.g., Peacock et al. 2012 [Ecological Applications 22] 1446-1459). Here, we evaluate the potential of combining elemental and strontium isotopic analyses of whole freshwater shells and shell temper fragments to trace the origin and circulation of shell-tempered ceramics within a single basin. A total of 260 samples are selected from twelve sites dated from the Late Woodland and/or the Mississippian period, all located in or adjacent to the Yazoo Basin (Mississippi) but along different drainages. The results are presented in three phases. The first one is the evaluation, by Scanning Electron Microscope and cathodoluminescence, of possible diagenetic effects on the material. The second one is the analysis of elemental and isotopic chemistry of whole shells to evaluate the variability of the geochemical signature within the basin. The third one is the comparison of the elemental and isotopic chemistry of shell temper with that of the whole shells and the evaluation of the impact of possible chemical exchanges between the clay and the shell temper.

Features of microstructure and chemical composition on historical glazed tiles in conservation studies (as exemplified by 18th Century Dutch tiles)

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The research is aimed to increase reliability of art historical expertise of ceramic art items by application of set of modern surface analysis methods of minimal destroying effect. Successfully applied in various fields of materials science, these methods are highly prolific in detection of typical features (“fingerprints”) in microstructure and composition of ceramics fabricated in various regions and periods. Methods mentioned are applied to the 18th Century Dutch underglaze painted tiles. They used to be part of living interior ensemble, though historical context lost. Nevertheless, they need to be studied and conserved as uniform complex, not separate items. It is the process of conservation, after dismantling and cleaning and before assembly and consolidation, that allows most thorough study of ceramic and glaze surface as well as genuine matrix that used to fix the tiles to the wall or furnace. Though loss compensation in such cases is usually made in non-ceramic materials, thorough genuine surface investigation should be regarded as essential part of conservation study and conservation / restoration program in alike cases. The microstructure of various layers of tiles (ceramic body, pigments, glaze) is examined using SEM JSM-35C (JEOL, Japan). Chemical and phase composition of specimens is determined by electron microprobe (EMP) using the wavelength X-ray spectrometer on the JSM-35C and XPS, AES, AEM, SIMS methods using electron spectroscopy installation ESCALAB Mk2 (VG, UK). The report provides information on microstructure details (glass to crystals relations, average particles and pores dimensions and their scattering), elemental and phase composition of layers including trace elements content revealed by SIMS. The results contribute to the database of historic pieces investigations, thus facilitating dating and attribution of objects of culture.

Firing conditions of LBK and SBK pottery from Eythra (Germany) using high-temperature analytics

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Basing on fabric, mineral and chemical composition studies, Neolithic pottery from Eythra (Saxony, Germany) provided by the “Landesamt für Archäologie” (Saxony, Germany) were characterized by means of in situ high temperature analytics. The studies of representative shards dated between 5400BC and 4500 BC were analyzed to determine maximal firing temperatures under oxidation conditions. Therefore thermo-analytical measurements by DTA/TG and DSC in air were carried out up to 950°C and 1000°C respectively. Additionally high-temperature x-ray diffraction (HT-XRD) measurements using two detector systems were applied within the same temperature range. The results of rough and fine pottery selected due to differences in color, hardness, ornaments, surface properties and shapes as well as of clay raw material from the vicinity of the shard excavation site allow suggestions of firing classifications: 1. organic-matter containing oldest LBK pots: temperatures of ~ 600°C - 700°C and low oxidizing conditions of the oldest LBK. 2. inorganic-temper and organic inclusion imprints containing pots: temperatures from the old LBK to the SBK period: different temperature ranges between ~ 800°C - 930°C. These studies are completed by multi-methodical pottery analytics especially of the chemical composition and iron oxidation state completing the firing suggestions and raw material provenance suggestions. Finally, method-critical considerations are carried out due to the resolution and significance of the temperature dependent measurements due to transformation phenomena of the raw material minerals to the ceramic phases.

Iranian Glazed Ceramics from the Alchemist’s Workshop in Bilyar

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***1** Kazan Federal University*

As part of the interesting and rich materials of the workshop of the alchemist, jeweler and glassmaker of the late 12th - early 13th centuries, there is small but expressive collection of Iranian glazed utensils. In this collection, only one fragment belongs to a wide open bowl or a dish made of light-red clay with polychrome painting on a white engobe under a colorless transparent glaze. The fragment belonged to, can be classified as Iranian product of the 11th centuries. This finding does not correspond to the time of the pottery workshop functioning and probably should be regarded as an accidental finding due to a digging - a breakage of an earlier stratigraphic layer. Other 19 pieces of Iranian fritware of different extent of preservation were made of fritware. The fragment of the fritware body wall with luster painting over opaque glaze was, obviously, a closed vessel of the albarello type. The surface of the bowl was decorated in such a way as if it was covered with the luster net, forming slightly convex cells with fine luster painting. Such bowls were produced in Kashan of the 13th century. A fragment of the bowl of minai type with enamel painting of light-blue, blue, red and gold colors is also recognizable, whereas Bilyar sites yielded only 6 fragments of this type. In order to obtain the technological characteristics and confirm the morphological attribution of the glazed ceramics, natural-science research methods were used. The physical characteristic of the vessels: mineral and phase composition of clay and the firing temperature, is determined by petrographic and X-ray phase methods. The chemical composition of the glaze, clay and fritware was determined by scanning electron microscopy (SEM). The report presents the results of these studies.

New frontiers for 3D surface analyses of archaeological pottery: developing new procedures for measuring traces of manufacture, use-wear and post recovery degradation through CLSM (confocal laser scanning microscope)

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While usewear analysis is a developing field of archaeology, the analysis of ceramic vessels is not very common. The surface of a vessel bears several type of traces and abrasions formed in different moments of its life cycle, and this makes it extremely hard to distinguish wear from production, use, and post-depositional processes. However, recent results of a pioneering study conducted on a group of vessels in black glossy ware from Rome suggest that high-resolution scans can be used successfully to determine the sequence of overlapping abrasions, and to develop ‘fingerprints’ for different types of wear. Building on these results a project has been devised in Catania University to create a protocol for the use of a CLSM to identify and measure traces of manufacture and usewear on archaeological pottery. This type of microscope is a latest generation laser scanning microscope that enables the distinction and measurement of the abrasions that are stratified on the surfaces of ceramic vessels, while also producing an unequaled 3D Imaging. It can therefore allow the definition of measurable parameters to discriminate the four type of traces which are more often encountered on the external and internal surfaces of ancient vessels: 1) manufacture traces; 2) use-wear traces; 3) traces due to post-depositional processes; 4) traces due to post-retrieval degradation. It is the first time that this experimentation in pottery studies is proposed, and it will be articulated in three stages: the first one will be conducted on archaeological material and it is functional to the recording, characterization and measurement of the various traces present on the surfaces of vessels from specific contexts of use, which can provide generic information on their function; the second stage will be carried out on experimentally reproduced vessels; the third will be carried out on the ancient vessels so as to measure any appreciable degree of degradation after 12 months. At the end of this experiment it will hopefully be possible not only to associate the traces measured on archaeological vessels to specific activities related to the sphere of production, consumption, but also to contribute to the conservation of the object, through the measurement of the deterioration of the surfaces pre and post recovery of the object from the soil.

The effect of wood-ash and charcoal on the elemental composition of ceramic bodies and their material properties

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The addition of wood-ash, likely in fine powder form, has been identified in secondary layers of clay applied to Roman period crucibles. These double-layered crucibles are a common occurrence at non-ferrous metalworking sites across the Roman Empire and previous research demonstrated the beneficial effect of lowering the refractoriness of the extra layer. Therefore, the addition of ash, which effectively acts as a flux, may suggest an empirical understanding of materials in the past. The addition of charcoal, on the other hand, has been identified in different periods and regions, in a number of ceramics associated with metallurgical processes, such as crucibles, hearths and furnaces, but also in domestic pottery. While the impact of charcoal tempering on thermal properties of the resulting ceramics has previously been investigated, our knowledge of the effect of charcoal and ash tempering on the composition and mechanical properties of clay-based ceramics is limited. This paper explores the impact of charcoal and fine wood ash temper on the elemental composition, (micro-)texture, and mechanical behaviour of ceramic bodies. To this end, a series of briquettes, with varying quantities of charcoal and wood ash added to the clay paste, have been manufactured. WD-XRF spectroscopy was employed to assess changes in elemental composition, while the influence of charcoal and ash tempering on textural and micro-textural features was investigated by thin section petrography and scanning electron microscopy respectively. Finally, material testing was employed to investigate the influence of the additives on the mechanical performance of the ceramics. We present the results of this experimental study and discuss the implications of our findings on investigations of ash and charcoal tempered archaeological pottery, and how it impacts provenance studies and the assessment of material performance.

Use of quantification of the orientation of aplastic components of a ceramic body for a study of the introduction of the potter's wheel in the La Tène period in Central Europe

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The potter's wheel is one of the principal technological innovations of the La Tène period. Its introduction is assumed to be a consequence of significant changes in the organisation of pottery production. Reliable methods for identification of differences in the application of rotation movement during forming are needed to gain a better understanding of the role of the potter's wheel in the La Tène pottery production. Identification of particular pottery-forming techniques based on the products of the manufacture is a complicated issue encountering problems associated with random observability and ambiguity of the diagnostic features. We developed a methodology to study the forming techniques based on quantitative analysis of the orientation of inclusions and voids in thin sections. The relationship between forming techniques and orientation of the components of ceramic materials in the context of pottery technology has long been recognised and used for identification of the techniques employed to create archaeological ceramics. The alignment of inclusions is usually characterised by qualitative categories or ordinal scales. The proposed quantitative approach provides an al-

ternative to qualitative classifications. Measurement of the orientation refines the analysis of preferred orientation by defining the exact intervals of orientation variability for particular forming techniques and their combinations. The presentation summarises the results of the application of the methodology on an experimental collection of pottery formed with different contributions of rotational movement. The results of the experimental research are applied to study the variability of pottery-forming techniques during the La Tène period in two different regions of Central Europe: the Chrudim region in Eastern Bohemia and Brno region in South Moravia.

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Wine economy in Picton territory (IInd century BC – Ist century AD) 2. Archaeometrical study of content

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In Picton territory, in the western center of Gaul, the existence of local productions of amphorae have been highlighted by several studies (Durquety et al., 2012; Lemaître, 2012). Local workshops copied the forms of imported amphorae produced in the north of Spain (Pascual 1 and Dressel 2 – 4), or in the Narbonnaise province (Gauloise 4 and 5) (Durquety et al., 2012b). To determine for what purpose these amphorae were manufactured in Picton territory, we undertook the chemical study of the organic residues that were preserved in the vessels. After extraction, these residues can be characterized by mass spectrometry coupled with gas phase chromatography (GCMS). This technique enables the analysis of a wide range of compounds, in particular coming from grapes and wine, such as tartaric, malic, fumaric, succinic acids. Alongside, it can allow the determination of red wine markers (tannins, anthocyanins), and even permit to obtain data on their conservation via the detection of resins. As part of this research, we used a technique developed in the 1960s, pyrolysis, to study organic macromolecules that cannot be directly analyzed by GCMS due to their low volatility. With pyrolysis, the extraction step, which is by definition restrictive since the chemical composition of the residues has to be known to choose the extraction solvent, can be avoided. The analytical method that we developed was applied on amphorae discovered in production sites (Gourgé) that were never used. First, to identify the observable molecules by pyrolysis with GCMS, amphorae shards were soaked in a wine of known composition. Then, archeological residues from amphorae discovered in Limonum were analyzed.

TECHNICAL CERAMICS

14

Preliminary archaeometrical approach on Glass fragments from Maadabad Hill

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Ancient glass, as rare archaeological findings in sites, which clarifying the skill and technology of artisans in controlling the furnace heat and know-how about the raw-mix in glass industry. Destruction and damages in historic glass happen through the effects of environmental factors on surface of the glass or through mass transfer due to changing the conditions from inside the glass toward the surface (leaching). The technology of glass production in Iran has been known since 1250 BC in south west of Iran. The chemical composition of raw material – raw mix – contained mainly from sodium, potassium compounds and calcium as a stabilizer and further more for decreasing the melting point of quartz. Sassanian Glass fragments came to light in recently excavation in Madabad Hill during years 2015. These fragments were varied in shape, form, colour and size. Some of these glass pieces were belong to different part of the original objects such as edge, body or handle whether each one was accompanied by one or more types of damages. Due to the glass destruction in burial setting, ancient glass has different defects depending on its application and the way of use. Four samples were analyzed with XRF and Thermo-analytical order to make a suggestion about the chemical composition of these materials as well as firing process at this time. Based on the instigations the glass fragments are classified in Ca-Mg glasses (high flux) and thermal expansions occurred around 1100°C

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Study of degradation processes of 16th century distillation apparatus

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Glazed ceramics of various utilization (dinnerware, distillation apparatus, building ceramics – floor or stove tiles) from the Late Middle Ages and the Renaissance period were excavated during several archaeological studies which have been realized from the middle of the last century to the present in the area of Prague Castle. This work deals with the characterization of the unique archaeological glazed distillation apparatus which was excavated from a Renaissance waste pit at Prague Castle. The distillation apparatus set consists of a distillation lid, two rectification bowls and a collection jar with two handles. The main aim of this work was to characterise the deterioration and degradation signs and their origin. Particular aims were the study of stress relations of glaze - ceramic body systems and the characterisation of unstable surface finishing (colours and pigments) and their chemical resistance using analytical methods. Causes and origins of defects of glazed surface layers were identified using X-ray diffraction (XRD), thermal analyses (STA, DIL), optical (OM) and scanning electron microscopy (SEM). It was proved that on the surface of the distillation set corrosion products were in the form of sulphates, chlorides and phosphates, namely calcium phosphates, sulphates and lead and copper chlorides. The presence of corrosion products in the form of inorganic acid salts was confirmed by XRF analysis. Fragments of the distillation apparatus set had been imbedded at different layers of the waste pit which had caused that the fragments had degraded differently. Based on results of thermal analyses it was proved that the ceramic body of the bowl contained the highest amount of clay components in the form of unstable metaclasses and had been the most exposed to thermal stress during its usage. This research has been supported by the grant NAKI II DG18P02OVV028.

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Technical Ceramics from the Jewelry Workshops of Saray al-Jedid of the 14th century

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During the excavations of one of the capitals of the Golden Horde - Saray al - Dzhehid - Tsar'yov settlement two jewelry workshops of the 14th century were discovered. Both workshops, located on rich estates in the eastern outskirts, worked with gold. The excavation materials represent the remains of heat engineering structures - hearths, jewelry tools, production wastes, as well as finished products made of gold. The workplace of the jeweler is marked with drops of gold on the pieces of the furnace on the walls and inside the melting vessels - crucibles. A total of 137 crucibles of varying degrees of preservation come from the workshops. Based on the fact that crucibles are the most illustrative tools for foundry workers, they were chosen as the main object of our research. Miniature vessels for metal melting had to have special physical and chemical properties. In many ways, the properties of crucibles depend on the dough composition, the shape and method of temperature exposure. To determine the mineral composition of clay and phase changes of mineral fractions under the influence of high temperatures, 10 samples of crucibles and fragments of hearths were examined with use of X-ray phase analysis. Determination of the chemical composition of clay dough, crucible slags and crucible composition (14 samples) were performed by scanning electron microscopy (SEM). The analyses revealed the use of special molding masses for crucibles, which were

different from clay dough used for tableware. Foundry crucibles were refractory materials capable to resist temperatures up to 1000 and above, as indicated by the phase composition - a complete thermal transformation, which led to the crystalline phase of the initially purified and finely ground material.

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The silversmithing ceramic crucibles of the islamic period (8th century) at Barcelona

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This poster shows an archaeometric characterisation on a group of crucibles that have been found during the excavations of the Saló del Tinell (Palau Reial de Barcelona), where the residences of power were located from the 6th century. They represent one of the few examples of archaeological materials from this period that have been recovered in Barcelona. The aim of the study is to investigate the intended function and the technical features of these ceramic pieces. Moreover, we have tried to shed new light on the transition from Andalusian to the Carolingian Barcelona and the workshops linked to the city's wali residence. The methodology of the research has considered the historical and archaeological information, but mainly the archaeometric analysis by means of X-ray Fluorescence (XRF), X-ray Diffraction (XRD) and Scanning Electron Microscopy (SEM) techniques. The crucibles show significant chemical and mineralogical changes related to their use that unequivocally point to a silversmithing activity.

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Ychma ceramics production technologies (1250 AD - 1530 AD), the case study of the site of Armatambo and the Sanctuary of Pachacamac

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Ychsma society was developed in the Central Coast of Peru from 900 AD until 1530 AD. The area that has been occupied by the Ychsma group corresponds to the low area of the Rímac Valley and the Lurín Valley, in the Lima department. The periods between the Middle Ychsma (1250 AD. – 1350 A. D.) and the Late ychsma (1350 A. D. – 1530 A. D.) on under study in this work by focusing on the ceramic production coming from the Archaeological site of Armatambo and the Sanctuary of Pachacamac. During the Middle and Late Ychsma periods, the archaeological ceramic studies have shown evidence of ceramic changes in their forms and decorative aspects. Nevertheless, technological aspects associated with ceramic production techniques have not been studied yet. To answer questions about the technical choices of Ychsma artisans, we compared many samples from the site of Armatambo and the Sanctuary of Pachacamac, corresponding to the two types of vases that are considered the most representative archaeological contexts: jars and “ollas” (pots). As part of our study, we performed observational analyses with optical microscopy. This procedure allows us to see macrotraces that let us identifying the assemblage techniques and the finishing of ceramic objects that have been made by craftsmen. The first observations allowed us to identify the use of the coiling as a shaping technique. Subsequently, physicochemical analyses (SEM-EDS, XRF, XRD) and petrographic analyses have allowed us to identify and characterize the components of the paste (clays and inclusions).

VESSEL FUNCTION AND VESSEL USE

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Food in context: preliminary interdisciplinary research on the dolia from the so called “wine-cellar” of thermopolium V 4, 6-8 at Pompeii

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This paper presents results of an interdisciplinary study based on the analysis of eight dolia found in situ in the so-called “wine cellar” of a thermopolium in Pompeii (V 4, 6-8). The building was archaeologically investigated by a team from Ca' Foscari University of Venice, between 2008 and 2009 (Zaccaria, Maratini 2015; Zaccaria et al. 2010). In order to better define issues related to space function and food processing within this complex, seven dolia were sampled for archaeometric analysis. Ceramic samples were mechanically cleaned, crushed to powder and subsequently analyzed by gas chromatography - mass spectrometry (GC-MS). Two extraction methods were carried out; the total lipid extract was obtained following Evershed et al. (1993) and Charters et al. (1993), while the extraction to identify wine biomarkers was obtained following Pecci et al. (2013). The filling of the dolia was also analysed in order to check for post-depositional contamination. The preliminary results of the analyses indicate

that all the dolia but one were coated with abundant pitch. In the majority of the samples, tartaric acid was identified. Although tartaric acid is present also in other fruits, for the period and area investigated it can be considered marker of grape juice. The presence of tartaric acid, succinic, malic and fumaric acid can be related to the presence of wine or its derivatives in the dolia. Two ceramic samples displayed compounds compatible with a plant oil origin; finally only one extract displayed lipid distribution suggestive of animal product, possibly fish. The paper illustrates and discusses archaeometric data within the framework of their archaeological contexts and in relation with epigraphic data present on some of the dolia, along with information provided by literary sources and other comparative evidence. The study here presented are part of the activities of the ERAAUB (SGR 2017-01173) of the University of Barcelona, the Ramon y Cajal contract (RYC 2013-13369), the RACAMed Project (HAR2017-84242-P), the Department of Humanities of the University of Venice and of the Scuola Interateneo di Specializzazione in Beni Archeologici SISBA.

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Secondary use and reuse of roman pottery – case study of local and imported forms in Viminacium

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As the most important provincial center of craft work, Viminacium wore the title of the capital of the Moesia Superior with right. It represented the main production core of pottery, especially vessels. On the other hand, diverse repertoire, starting from kitchen, dining, warehouse, transport or ritual, testify about the workmanship and skill of pottery masters and their need and ability to satisfy the demand of the population. The pottery craft was certainly on the high level, regarding the quality and quantity of the recorded opus of the vessels. Regardless the function, due to their everyday use, pottery vessels were susceptible to breaking and fraying, and the significance of these vessels is reflected in their reparation. Finds of these vessels in secondary use and reuse testify in favour of this. Pottery with altered primary function is recorded in the explored areas of Viminacium, most often on necropolises, while the findings in the urban and suburban areas are few. Vessels in the funerary context, defined as urns, are mostly represented in the graves with the cremation and in only a few exceptional cases occur in graves with the inhumation of individuals. Usually these are common to kitchenware, i.e. pots with extended and changed function, of local origin, while the imported vessels in the graves actually represent the true rarity. Besides the containers in secondary use, finds of vessels with reparation, or a changed purpose, originate from the Viminacium territory as well. Here can be speak about the vessels on which repairs have been made, those which lost the original character after a while, or fragments of vessels that could have the function of a certain tool. In this research, an attempt was made to interpret and understand the pottery craft and the role of ceramic vessels in the lives of the local population of Viminacium.

Structural modeling of ceramic vessels - Understanding Function, Assessing Design

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The thermo-mechanical performance of particular ceramic materials can be investigated in the laboratory through material tests of specimens with standardized geometries either cut from the ceramics or prepared as replicates. This allows for assessing production parameters, such as raw material selection, clay paste preparation and firing conditions. The effect of vessel shape, on the other hand, is more complex and difficult to examine because material tests are commonly destructive, which precludes testing of intact archaeological vessels, and production and testing of exact replicates involves considerable uncertainties. Alternatively, digital 3D models of specific vessel shapes can be generated, for example on the basis of two-dimensional profiles extracted from drawings or photographs, which are digitalized and rotated in a CAD program. Another approach is to generate digital models directly from a ceramic object either by using a 3D scanner or by using computer tomography. Taking into account the material properties of the actual ceramics, which were determined in the laboratory, the models can be tested for their performance under simulated thermo-mechanical loads using the finite element method (FEM). In this way particular shape parameters can be investigated and different vessel shapes can be assessed for their performance. The simulation approach provides information about function and use of ceramic vessels and allows for interpreting observed damages caused by potentially critical loads. Constraints, such as points of load and support, can be arbitrarily adjusted. Furthermore, models can be tested under time-dependent loads in any interval, allowing for simulating static as well as dynamic loads.

Use and function of ceramic vessels from a larder of roman tabernae in Emporiae. A set originating from sector 25000 of Insula 30

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The beginning archaeological works beginning in 2000 of Insula 30, exposed a new urbanistic block of the roman city of Emporiae. This new surface had 2 X 1 roman actus equivalently to 70 x 35m. The excavation in the half north of this space located the first public thermal complex of the city, created in the 1st century which perdured to last third of the 3rd century AD. However, in the south of this space there were a set of roman tabernae with artisanal and commercial use, with a chronologies comprise the 1st-3rd century AD, builded on the ancient

republican domus. The set, which we present, comes from the first phase of the tabernae (sector 25000), in the area southeast of the Insula 30. During the excavation in autumn of 2017, there was localized the warehouse of the establishment in his first phase, cutting the rock and amortized voluntarily at specific moment, with an important volume of material which stands out for his variety. The functional study of these material will permit know the material culture which was use during this historical specific period, as well as to deepen the knowledge of the sector and to make an approximation their activity. In addition, brings us closer to the reality of a roman tabernae located in one of the most central places of Emporiae for his proximity with the forum and the public baths of the city.

PRODUCTION CENTRES AND RAW MATERIAL STUDIES

Archaeological and archaeometric studies on Sub-Koan amphorae from Akrai/Acrae, SE Sicily

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The aim of this work is to present the results of archaeometric and archaeological studies on the particular type of pottery - Sub-Koan amphorae in the scenario of an interdisciplinary research project (1,2). This remains come from the archaeological site Akrai/Acrae, localised near modern Palazzolo Acreide (Syracuse, Sicily). Akrai, founded by Syracuse in 664/663 BC and developed in the shadow of metropolis, in 212 BC become a part of first Roman province, as other Sicilian towns. The results of the recent studies show that the investigated area was almost continuously occupied. The pottery which will serve for this interdisciplinary research are considered the most important and widespread type of container for wine in the Mediterranean and Black Sea basin during the early Roman Imperial period. There were numerous variations of these amphorae, characterized by different types of clay, produced in many centers (from east to west in the Mediterranean world). This is related to the fact that sub-Koan amphorae were produced in many centres, located in eastern and western parts of Mediterranean world as well as Black Sea basin. The period of their production is dated from the late 2nd/early 1st cent. BC to at least the 2nd cent. AD, with some exceptions. In this context, in order to determine the origin of the ceramic production, petrographic, mineralogical and chemical analysis, were carried out. Thanks to the comparison between the petrographic and the chemical analysis the hypothesis of different production centers is confirmed, while mineralogical data allow us to suggest firing temperature. Furthermore, the comparison between portable XRF data and laboratory analysis has been carried out in order to standard-

ize the measurement will be obtained in situ. 1. Barone, G. et al. Evaluation of the technological features of late roman cooking ware classes from Akrai (Syracuse , Sicily). MAA 16, 171–183 (2016). 2. Barone, G. et al. “ Romanization ” of Sicily: an archaeometric study of plain table-ware classes from ancient Akrai (Sicily). MAA 16, 157–170 (2016).

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Archaeometric Characterisation of the Roman Pottery from the Workshop of Felanitx (Mallorca, Balearic Islands)

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Rescue excavations of a building on the actual village of Felanitx, in the eastern part of the island of Mallorca (Balearic Islands) documented a stratigraphic sequence with several phases, including evidence of the Roman past. Particularly important are the Roman ceramic materials recovered from different pits. A high percentage of the ceramic material recovered from these pits shows clear signs of being overfired. This was a clear sign that pottery-making activities were developed at the site probably linked to a Roman villa or to another form of rural settlement. The ceramic workshop produced common and cooking wares as well as building materials (tiles) dated to the Early Roman period. This contribution presents the interim results of the archaeometric characterization of 95 samples of the supposedly locally produced ceramics, by means of WD X-ray fluorescence, X-ray diffraction and Optical Microscopy by thin section analysis. The results show clear differences in both technology and raw materials used for the different kind of ceramics. The cooking wares are mainly low or border calcareous with only very few exceptions, while both common wares and tiles were made with much finer calcareous clays. The local character of the raw materials is highly plausible. Nevertheless, the results show a great variability and aspects that must be resolved in the future with an extended study of the raw materials available in the area. Nevertheless, these first results allows for the establishment of the reference groups for the different wares produced at the site. This contributes to the regional study of production, distribution and consumption of ceramics during the Roman period in Mallorca.

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Ceramic oil lamps from the Agora of Nea Paphos: integrated results of multidisciplinary research on Hellenistic-Roman local production

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Ceramic oil lamps were used throughout the Mediterranean as a basic light source, popular not least thanks to easy access to fuel, mainly olive oil. In Cyprus, they are known from the Middle Bronze Age (2000-1600 BCE). During the Hellenistic (late 4th-late 1st c. BCE) and Early Roman (late 1st c. BCE-mid-2nd c. CE) periods, their form and manufacture allow for distinguishing four types with distinct chronological ranges. Wheel-thrown open lamps, dating back to the Bronze Age, were still in use in the 3rd c. BCE. The Classical period saw the advent of thrown closed lamps which increased in popularity up to the 2nd c. BCE. Manufacture and use of molded closed lamps began in the mid-2nd c. BCE and continued into the Roman period. In contrast to the Hellenistic molded lamps, Early Roman molded lamps are characterised by more closed shape, having only a small hole in the central disk, and extremely thin walls. During the excavations at the Agora of Nea Paphos an assemblage of oil lamps with representatives of all four types was unearthed. Based on typological, macroscopic fabric and quantitative analyses all types are suspected to have been produced locally. In order to verify this assumption and to reconstruct manufacturing technologies and chaînes opératoires involved in the production of these different types of oil lamps, 64 samples, covering the macroscopic variability, were analysed through wavelength dispersive X-ray fluorescence spectrometry and thin section petrography, supplemented by scanning electron microscopy. For the locally produced lamps, compositional variability between but also within the above groups was observed, related to chronological, technological and stylistic parameters. The implication of results on our understanding of the local oil lamp manufacture and of shifts in production technology over time will be discussed, taking into account the changing social, political and economic context.

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Characterising Cetina ceramic technology: Comparing pottery making recipes in Bronze Age Central Mediterranean

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The proposed poster presents the first results of petrographic analyses on Cetina and Cetina-like ceramics from key sites of Dalmatia and the Peloponnese. This study aims at addressing some aspects of the so-called Cetina phenomenon that have not been investigated as yet. The Cetina culture arose in Dalmatia in the mid-3rd millennium BC. It is mainly known for its burials consisting in inhumations or incinerations under stone barrows that are often grouped together to form clusters. Distinctive Cetina ceramics are bowls with thickened rims and beakers decorated with geometric incised and impressed patterns. During the second half of the 3rd millennium BC pottery strongly characterised by Cetina features spread across the central Mediterranean and this is widely considered to be evidence of a vast network of interconnections reflecting the movement of small human groups. In particular, Cetina-like ceramics have been found at a number of Early Bronze Age sites in the Peloponnese. However, aside from a stylistic comparison, nothing has been done to explain differences and similarities between these ceramics from a technological point of view. Given the huge differences in pottery traditions from Dalmatia and the Peloponnese in the Early Bronze Age, this matter is of particular interest. Analysed sherds from Dalmatia come from three clusters of tumuli: Brnjica, Poljakuše (Šibenik) and Vučevica (Split), while samples from the Peloponnese come from the sites of Olympia and Andravida Lechaina (Elis), which have yielded a number of Cetina-like sherds. These analysed sample sets have common stylistic traits, but also technological differences that sometimes can be macroscopically recognised. This variation might result from natural variability in the available raw material sources. On the other hand, it might be due to specific technological choices and traditions possibly linked to the existence of multiple communities of practice under the umbrella of the Cetina phenomenon.

30 **Compositional characterisation of Roman pottery production at Municipium Claudium Iuvavum (Salzburg), Austria**

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The Roman municipium at Salzburg (known as Claudium Iuvavum), located in the western part of Austria (known as Noricum), was an important centre of pottery production. Seven workshops were discovered in different parts of the town, and they were active between the middle of the 1st century AD and the 3rd century AD. Examination of the waster vessels found in the various kilns and pits permitted to reconstruct the typo-morphology of the local Roman products. By combining macroscopic and mineralogical analysis of the waster sherds, this study investigates the evolution of Roman ceramic technology over 200 years. Intra- and inter-kiln variability among the sherds has been examined in detail, using optical microscopy and electron microprobe analysis. The compositional analysis has made significant contributions to various aspects of potters' technology, and allowed to reconstruct the operational chain, including raw material selection, paste preparation, forming and firing. Several com-

positional patterns have been identified, and they appear to be correlated to a continuity in potters' selection and manipulation of raw materials. These patterns can be used to identify the Salzburg products at consumption sites located in western and wider Noricum, providing a firm basis for inferring aspects of regional trade in this part of the Roman Empire. Acknowledgements: The detailed compositional study was financed by the University of Salzburg, Austria. C.I. acknowledges support of the Romanian Ministry of Education and Ministry of Research through the UEFISCDI/CNCS project PN-III-P4-ID-PCE-2016-0229.

31 **Export blue-and-white porcelain from the Witte Leeuw Shipwreck**

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Over the many centuries of international trade between Asia and Europe, the two different cultures were beginning to exchange not only goods but also ideas. Chinese porcelain, the main kind of cargo in the ships, shaped the history of international trade during that long period, especially after the 17th century, when the Dutch East India Company (Vereenigde Oostindische Compagnie, 1602-1799) dominated the overseas market, mainly consuming Blue-and-white porcelain. The Witte Leeuw (White Lion) was a VOC ship that was lost on its homeward voyage near St. Helena, caused by a naval battle with two Portuguese galleons in 1613, which is the period of Wanli (1573-1620) in China. According to the copy of cargo loading list from the Dutch National Archives at The Hague, it was returning with spices, Ming porcelain and diamonds, etc. It is famous for its well preserved blue-and-white porcelain, especially kraak which is a typical decoration pattern made for export. Dr Christine van der Pijl-Katel and some scholars have a comprehensive analysis of the typology of the ceramic by 1982; however, since then no further research on the ceramics have been done. Twenty samples from the Jingdezhen and Swatow (Zhangzhou) blue-and-white porcelain sherds, containing the shapes of bowl, cup and plate, were selected to be tested by SEM-EDS and Raman spectroscopy. The chemical composition and microstructure indicate that the blue pigment of Jingdezhen wares was unique in being a mix of local and imported cobalt and that the glaze of the Swatow consisted of two layers of glaze.

32 **Features of the chemical composition of monochrome glazed ceramics 14-16 centuries Iske-Kazan (Russia)**

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Despite the fact that the archaeological glazed pottery with turquoise, green and brown glaze has a wide area of distribution and quite often found among the findings of excavations of the Middle Volga, there is still no definite answer about the place of production of this type of dishes. It is known that this type of ceramics is characteristic of the settlements of both the pre-Mongol time and the period of the Golden Horde. In this paper, we studied the chemical composition of monochrome glazed ceramics from the excavations of the Kamaevsky settlement and the Russian-Urmat settlement, located close to each other and belonging to the settlement of Iske-Kazan. The first arose in the second half of the 13th century as a result of the resettlement of the inhabitants of the Bulgarian cities after the Tatar-Mongol invasion and was destroyed by the troops of Ivan the Terrible in 1552. Archaeological finds of the second settlement indicate an earlier existence - 12-14 centuries. A characteristic feature is the color palette of ceramic. Finds with turquoise glaze are found in both excavations. There were found fragments painted in brown on the Russo-Urmatsky settlement, while this type of ceramics is painted green on the Kamaevsky settlement. The chemical composition was studied by optical spectroscopy (emission spectral analysis), which allowed to determine both the major and trace elements. Almost all glaze has the lead base, only three samples of turquoise color, one of which was found in the Russian-Urmat settlement, and two - on the Kamaev settlement, are watered with sodium glaze. It can be noted that low concentrations of tin are characteristic of all samples of the Russian-Urmat settlement and two fragments from Kamaev. The same interesting information was obtained in the study of the chemical composition of ceramic paste, confirming the continuity of sources of raw materials in the production of glazed ceramics. This may serve as a basis for the assumption of the local nature of the dishes. Comparison of the analysis of monochrome glazed ceramics of these two settlements with previously obtained information on the ceramics of the Kazan Kremlin, Bilyar and Bolgar can provide information about the continuity of the sources of dishes and craft schools of this time.

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From prayers to traders. Changes in ceramic technology and their social implications at the Vinalopó and low Segura valleys from mid-6th to 1st millennia cal BC

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Forming part of a broader study of ceramic technology in Eastern Iberia, Spain, this research examines change in pottery over several millennia. The area under consideration hosts continuous occupation from the mid-6th millennium cal BC, which marks the beginnings of food production in the area, associated with the NW Mediterranean Impressed-Cardial cultural complex. From the 3rd millennium cal BC (Chalcolithic), autonomous local cultural groups

start to develop, characterized by material culture that, while connected, is clearly differentiable from that of neighbouring regions. This local development continues during the Bronze Age, a period characterized by changes in social and political structures, accompanied by the first signs of social ranking. In this paper, the preliminary results from the petrographic study of the ceramic assemblages recovered at the sites of calle Colón (n=6) (5480-5310 cal BC), Peñón de la Zorra (n=14) (2400-2100 cal BC) and Peña Negra I (n=21) (925-725/700 cal BC) are presented. Each of these sites is representative of local communities embedded in different social and economic systems, exhibiting important differences in pottery consumption and production patterns. The data obtained show discrepancies between Neolithic and Chalcolithic pottery production sequences, with a much higher compositional variability in calle Colón, associated with important morphological and decorative variability. In contrast, the assemblage from Peñón de la Zorra displays a marked technological regularity. Finally, preliminary results from Peña Negra I suggest a typologically homogeneous assemblage, formed in elaborate hand-made fine-ware, but associated with rather diverse production sequences. This later case probably reflects a complex internal organization of the village, with several production units working contemporaneously, as well as reflecting its important role in the distribution of food and goods at a regional scale.

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Investigation into the industrial production of porcelain in the Vieillard and Cie manufactory (Bordeaux, France, 19th century)

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During several decades of the 19th century, the French Vieillard and Cie manufactory produced porcelain, among other things. Recently, throughout archeological excavations in Bordeaux (France), waste dumps of the Vieillard and Cie factory were discovered and have provided significant quantities of porcelain fragments. Before this archeological discovery, the share of porcelain production remained almost unknown. As a matter of fact, the quantity of pieces produced was significantly underestimated. The reasons are multiple and include the fact that: (1) in most cases porcelain is not decorated and (2) it would seem that porcelain generally does not have a stamp. Consequently, archeological excavations in the ancient factory area and representative sample collection allowed us to explore the evolution of the porcelain production in Bordeaux. The present research focused on the technical evolution of the porcelain productions during different chronological periods of the factory life. In order to do this, a group of twenty-eight sherds, which are representative of three successive production periods of the manufactory between 1851 and 1895, were analyzed. In most cases, their dimensions allowed us to recognize the shape and the use of the original objects (vase,

isolator, saucer...). A multianalytical characterization was performed using a combination of methods that included chemical and mineralogical analysis (SEM-EDS, PIXE and XRD). The chemical composition and the microstructure of porcelain body and glaze were investigated in order to collect information on ceramic characteristics and production technology. The results allowed us to establish two compositional groups, which differ both in the composition of glazes and bodies. It should be noted that the distinction between the different periods could be explained by the modification of the flux nature. To conclude, hypotheses about body and glaze recipes were formulated and the data obtained were compared with the available information in the 19th-century treatises.

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Investigation of Late Roman Pottery from Gadara of the Decapolis, Jordan Using Multi-Methodic Approach

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Selected fragments of late Roman pottery sherds that were excavated from Gadara (Um Qais), North Jordan were investigated using multi-methods approach (i. e., typology and archaeometry) in order to learn more about the daily life of Gadara of the Decapolis during the late Roman period. In addition to traditional typological analysis, the samples were analyzed as to their mineralogical content using petrography and XRD, their chemical composition using EDXSEM, and their internal microstructures using SEM after refiring some samples between 700 °C and 1100 °C. The results indicated that the Roman potters at Gadara manufactured jars, bowls, and juglets using ferruginous calcareous clays with minimum improvements, while they improved the wares of the cooking pots either by firing at the proper temperatures or selecting and processing the raw materials to fulfill their use. The available raw materials in Gadara and its surrounding seem to be good enough for pottery making, thus, there was no need to import such vessels at that time.

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Multifaceted Analysis of Glazed Ceramics from Jordan: Raw Materials and Technological Aspects

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The aim of this work was to study the chemical and Micro-structural composition of Ayyubid/Mamluk glazed ceramics excavated from Tal Al Husun, Jordan. The investigations were conducted to obtain information on raw materials and their technical processing (provenance and technology). To identify the clay materials and the glaze, ceramic bodies as well as glazed lay-

ers were analyzed using ICP–AES, optical microscope and X-ray diffraction (XRD). According to the clay paste and ceramic color samples were classified into four groups. Results revealed that the ceramic object was made of a homogeneous paste (non-calcareous, non ferrous clay) containing a high proportion of quartz, the study indicated that ceramic samples had a high lead (Pb) content. This type of glaze was prepared by brushing the body of the pottery vessels with a mixture of lead and silicate solution. The analysis by scanning electron microscope, X-ray diffraction and optical microscope showed that the Ayyubid/Mamluk potter fired his pottery in a double-combustion method at a temperature exceeding 1000° C. As for the raw material used in the manufacture of clay paste, evidence shows that the pottery body was made of local source material, while the glaze material was not locally available and this is evidence that it was imported.

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Open Fabric 3.0: collecting, geo-referencing and characterizing archaeological ceramics from Tuscany in an open-access and open-source online database

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Ceramic objects are extremely valuable material culture's indicators. Every archaeological campaign provides a wide amount of materials and data, including typological classification, stylistic analysis and dating as well as analytical results among which mineralogical and chemical records. The synergy of archaeological and archaeometric methods supports, in fact, the identification of provenance and technology in pottery studies as a first step towards the interpretation of the ancient societies. To achieve the comprehension of those aspect is extremely useful a comparison between new dataset with reference groups and experimental laboratory samples obtained by using the most likely sources of raw materials. In this respect, the possibility to access to all those data for comparative studies is sometime limited by the scattered and often partial shared information in different papers and scientific platforms. The project Open Fabric 3.0 aims to fill this gap in creating one single online and open-source ceramic database by using geomatic tools; it is focused on a wide dataset of ceramics dating from the Late Antiquity to Middle Age found in Tuscany between Arno and Cecina valleys. Open Fabric, inspired by various databases recently created, on different scales in Europe (Facem Project, 2011; ceraDAT, 2012; Petrodatabase, 2012; Archaeology Data Service, 2013; Wikipottery, 2015; BasePetroCeram, 2015), is still under construction. It provides, for every archaeological artifact or laboratory sample, both mineralogical and typological description, with also drawings and microphotographs implemented with multidisciplinary datasets as Raman spectroscopy, cathodoluminescence spectrometry, X-ray fluorescence analysis and other innovative archaeometric methods. Each target is geo-referenced, following the principle of GIS tools, to better visualize the distribution of a specific fabric/typology on regional scale. The database will be soon available online; even if it is assessed on the only Tuscany region, the project would be the starting point for a national scale open ceramic database.

Overview of the ceramic technology from Late Neolithic to Copper Age in the Southern Carpathians, Romania

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The archaeological research in the ‘Great Cave of Cerișor’ (Southern Carpathians, Romania) revealed potsherds which were assigned to the Turdaș culture (Late Neolithic), the Foeni group (Neolithic to Copper Age transition) and the Coțofeni culture (Copper Age). The potsherds were investigated by polarized light optical microscopy (OM), X-ray diffraction (XRD) and electron microprobe analysis (EMPA) in order to determine the evolution of the pottery technology from Late Neolithic to Copper Age. The sherds were compared with clayey raw materials sampled in the surroundings of the site. The OM shows that the Foeni samples are fine-grained, whereas the Turdaș and Coțofeni are coarse. For all samples, quartz, micas, feldspars are the main clasts. Heavy minerals are rare. Lithoclasts, Fe-rich concretions, clay pellets and ceramoclasts (chamotte) are also present in all samples. Some of the Turdaș and Coțofeni sherds display fragments of limestone and crystalline carbonate rocks, as well as fossils. The X-ray diffractograms contain the main peaks of quartz and feldspars. The illite/muscovite 1 nm peak shows various diminishing degrees. The composition of the clay samples matches well that of the sherds. The inferred firing temperatures are higher for the Late Neolithic Turdaș and Copper Age Coțofeni samples, i.e. between 800 and 900°C. The Foeni sherds, dated to the transition period between Neolithic and Copper Age, were fired to a slightly lower temperature, estimated to be ~800-850°C. The production site was probably the same, located nearby a river where clays are cropping out. No remnants of kilns were found in the surroundings, indicating the use of primitive firing devices. Financial support from the Romanian Ministry of Education and Ministry of Research (UEFISCDI/CNCS project PN-III-P4-ID-PCE-2016-0229) is acknowledged.

Petrographic and X-ray diffraction analysis of the ceramic body of late Roman glazed ceramics found at Környe (Hungary)

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Two late Roman pottery kilns were found during archaeological excavations at Környe (Quirinum in ancient times). The locality is situated 5 kms southwest from Tatabánya in Hungary, on the northern side of the former Pannonia province. The kilns made of stones are situated at right angle to each other in the economic area of a villa and used the same pit. The site is characterised by the presence of glazed vessel fragments, most of them found in one of the kilns, and solidified melts of the kiln material. As a first step to determine the production technology of the glazed vessels, the ceramic body were studied by polarizing microscopy and X-ray powder diffraction analysis. Based on the texture, type and proportion of mineral particles and rock fragments the ceramic body of the findings can be classified into two main groups. Most of the ceramics (Group 1) are poorly-sorted, containing medium silt to coarse sand sized non-plastic inclusions (up to 1200 µm). Based on the variable proportions of the different non-plastic components and the diversity of the matrix (various amount of micas) four subgroups are present. The significant non-plastics are quartz, plagioclase, biotite, altered amphibole, quartzite, quartz phyllite, chert and micritic limestone. In contrast, some of the investigated vessels (Group 2) are medium to well-sorted, fine-grained ceramics. Besides non-plastic mineral particles (mainly quartz, less than 150 µm in size), argillaceous rock fragments (900°C).

Roman and Late Roman Common Wares from the rural site of Sa Mesquida (Mallorca, Balearic Islands): local production?

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The remains of a villa including a pottery kiln were located during the archaeological excavations carried out in the 80's at the rural site of Sa Mesquida (western Mallorca). The kiln for relatively fine calcareous common wares and several deposits with discarded materials (over-fired) were evidence of pottery-making activities dated to the Early Imperial period. Recent excavations have revealed that the villa was founded at the beginning of the Augustan period or slightly earlier. The main building was destroyed by the end of the 2nd century or early 3rd century. The kiln and a cistern were re-used later as rubbish dumps in the Late Roman period. The Late Roman common wares discovered at the site resemble to the pottery produced at the Early Roman kiln and this fact generated a series of important questions to solve. Were the common wares produced only in the Early Imperial period? Are any of the common wares found in Late Roman layers still a local product? Are the examples found in Late Republican or Augustan layers already a local production from the site? These questions are essential in order to understand the time-span of the pottery production at the workshop. In order to address these issues, several common wares from different well-stratified layers have been archaeometrically characterized using a combination of techniques (WDX-Ray Fluorescence, X-Ray Diffraction and Optical Microscopy by thin-section analysis). This contribution pre-

sents the result of the archaeometric characterization of these common ceramics and their comparison with the reference group of the production already defined in earlier works. The results provided a better understanding of the ceramic production of common wares at the site in a diachronically perspective.

41 Setting the technological patterns in the Neolithic pottery production of central Apulia

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The results discussed in this paper represent an initial overview of the Mid-Late Neolithic Serra d'Alto pottery of the Murge area. The frequent occurrence of the same fabrics in different contexts suggests the circulation of technological models. To understand the technological properties as relating to raw materials, clay preparation and firing, a group of 78 samples was subjected to petrographic analysis on thin section. The principal aim was to identify differences or/and analogies between ceramic materials from different geographical and archaeological contexts (settlements and caves), and to verify the existence of technological model exchanges. The potsherds analysed belong to figulina (no. 44), fine (no. 20) and semi-fine paste (no. 14) groups. All the petrofacies are compatible with the karst environments of the sites studied. The pastes are mainly associated with residual clays (i.e. terra rossa). The quartz-bearing fabrics are more widespread in the hinterland, close to the lame, the typical broad, shallow valleys covered on the bottom by colluvial terra rossa and calcareous sand eroded from calcarenites. Fabric KB, by contrast, rich in calcareous sand and bioclasts, is associated with the shoreline. The fabrics with prevalent spathic calcite, of speleothemic origin, were interpreted as tempered, whereas smaller amounts of spathic calcite and/or calcareous sand were more probably part of the clay. As for the archaeological wares, the fine-brown painted figulina pottery is associated with quartz-bearing fabrics and with terra rossa, naturally available with the characteristics observed in thin section. The semi-fine and coarse wares present more variable relations with fabrics and probable different strategies of clay exploitation and/or processing. These preliminary results represent an initial overview of Mid-Late Neolithic material culture in the Murge area through the comparison of pottery samples from various contexts, highlighting technological patterns and showing a local production at every archaeological site. Ongoing research at a larger number of sites in the same area will confirm/refute these preliminary results.

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Technological transfer in pottery making, Neolithic Northwest China

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This project investigates the distribution of Neolithic pottery technologies in the modern Chinese Provinces of Gansu and Qinghai, at four sites located in the valleys of the Tao, Yellow and Huangshui Rivers. Focusing on the pottery attributed to the Majiayao archaeological culture (5300-4000 BP), and examining pottery production from the perspective of technological choice, the project seeks to shed light on patterns of technological transfer, communication and exchange, and on the social life of the communities in this area.

Majiayao-style pottery shows a very distinctive repertoire of forms and decoration, and has been found extensively throughout these valleys, at sites located over 200 km apart. Such apparent close stylistic similarities spread over such a wide geographic area raise numerous interesting questions regarding how and where the pottery was produced: Was pottery centrally produced and physically distributed, or rather were only the ideas of styles and pottery technology transmitted? What impact might the rivers themselves have had on the movement of objects or ideas? And how might potters have responded to different local resource environments, or developed local technological traditions?

This study compares Majiayao-style pottery from the type-site of Majiayao with that from a nearby site and two more remote sites, using ceramic petrography and scanning electron microscopy to investigate ceramic paste composition, forming technology, surface finishes, and firing conditions. By looking at the technological choices made throughout the production process, this study addresses questions of potential long-distance pottery trade as well as local raw material use and production technologies characteristic of the Majiayao-style.

Understanding the technological characteristics of the Majiayao-style pottery will enhance our knowledge about the interconnection of Neolithic communities and provide insights into the role of pottery vessels and pottery style and technology as mediums for communication over long distances. This project is the first comparative study on pottery technology in Neolithic Northwest China which incorporates material from sites in different river valleys and will provide a starting point for future research on pottery production in the study area and beyond.

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Tempering with white marbles: implications on the provenance and production technology of ancient pottery

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The addition of temper in the pottery production is attested since prehistoric times and is still a production choice adopted in modern ceramic industry. When the temper is composed of minerals and rocks outcropping in areas far away each other, new questions on the production technology arise. Such situations can be explained considering the recycling of imported rocks, including those used for architectonic elements or sculptures, mainly coming from buildings of previous epochs. This study presents the evidence of the deliberate addition of recycled white marbles on a long term production (4th and 14th century AD) of coarse and cooking ware in north-eastern Italy. The petrographic analysis of about 200 potsherds, attested the use of this unusual kind of temper, in addition to the classic spatic calcite, on about half of the repertoire. The occurrence of different type of marbles, associated to rocks and minerals typical of the alluvial deposits of the eastern Po plain as well to locally available rocks (Euganean Hills trachyte), clearly pointed out the intentional addition of recycled marble fragments, and allow to exclude that the pottery was imported from other regions. Detailed petrographic analysis on the microstructure, maximum grain size (MGS), accessory minerals (when observed) and grain boundary shapes, allowed to constrain these marbles to the most important Mediterranean classical sources area. These data were also partially confirmed by the stable oxygen and carbon isotope analysis on marble fragments mechanically separated from the ceramic paste. Nevertheless, part of the marble fragments were characterised by very negative ^{13}C values, not consistent with any marble variety. A series of firing experiment on marble fragments were carried out in the temperature interval between 500°C and 800°C , both reproducing oxidising and reducing conditions, to evaluate whether these anomalous ^{13}C values could be related to the firing process.

45 The chemical composition of the Migration period hand-made ceramics from the excavations of the medieval city of Bolgar (Russia)

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The paper is focused on the study of the Imen'kovo culture ceramic vessels dated to the Migration period (5th -7th c. CE) and found in a course of archaeological excavation in the city of Bolgar, the capital of medieval Volga Bulgaria. The archaeological investigations of Bolgar site are focused on the period from the 10th to the 14th c. CE while the reconstruction of the initial stage of the development of Bolgar area dated to the middle of the 1st millennium CE is complicated by severe damage of the stratigraphic layer caused by later human activities. These obstacles make any kind of data referred to the early stages of settlement there extremely valuable. A collection of ceramics from recent investigations which comprises shards of gray and brown thick-walled pots with a mixture of grog (reduce to fragments ceramics) was examined in this study. The color pattern of the shards approves that the vessels were fired in hearths. The chemical composition was examined by an optical microscope (emission spectral anal-

ysis). Through the examination, a high-scale admixture of barium (BaO) was identified as a specific trait for the most part of samples. The samples with a high level of barium also have an admixture of domestic ruminant animals manure that was charred in a course of reduction firing. Such a high content of barium was previously recorded in the Volga Bulgarian ceramics of the pre-Mongolian stage dated to the 10th-12th c. CE. This applies both to manure-admixture ceramics and shards with an admixture of ground shells of river mollusks. In all the cases a kind of water rich in barium could be considered as a source of this element in ceramics. Hydrogeological maps indicate several locations with a high level of barium-rich ground water in Tatarstan. By contrast, the Golden Horde period pottery (13th-14th c. CE) have no traces of remarkable barium admixture. It was not also detected in the shells collected at the banks of the Volga River, which is the largest regional hydrological unit and a nearest large river to Bolgar. This suggests that the Imen'kovo culture ceramics producers, as well as potters of pre-Mongolian Volga Bulgaria, used the same specific sources of raw material while the Mongolian invasion dramatically changed the organization of pottery production in the region.

47 The modern ceramics from Manises (Valencia). A reassessment from the new excavations at Barri d'Obradors

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In 2011 starts the investigations of the Museo Nacional de Cerámica "González Martí", the Museu de Ceràmica de Manises, the Asociación de Ceramología and the Ayuntamiento de Manises through systematic archaeological excavations in the workshops of the called Barri d'Obradors in Manises (València). The excavation on 17 Valencia Street begins in the year 2014 and the pottery found shows the evolution of the production from the fourteenth to the nineteenth centuries. Before this project, these workshops have been principally explored in archaeological urban rescue. In a first phase, 39 majolica individuals have been chemically characterized by means of x-ray fluorescence analysis (XRF) and mineralogically by means of x-ray diffraction analysis (XRD). According to the results, a subsample has been further investigated by means of Scanning Electronic Microscopy (SEM-EDX) in order to assess their sintering state and microstructure. The team ARGUB (Cultura Material i Arqueometria) have diverse studies of glazes for the majolica from Barcelona, Talavera de la Reina, Sevilla and Muel. All of them are related to the Tecnolonial project (Technological impact in the colonial New World. Cultural change in pottery archaeology and archaeometry – HAR2016-75312-P). The incorporation of more archaeological workshops as Manises, can allow us to deep in knowledge the complexity of glazing technique through the observation of the diversity over the Iberian Peninsula. In the present poster, we will present the first results of this case study.

The study of medieval pottery: the case of Torrentejo in the northwestern Iberian Peninsula

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In recent years, the study of medieval and modern pottery of the northwestern Iberian Peninsula has experienced a flourishing interest that has resulted in new enlightening data, posing new challenges and problems. This work aims to provide new preliminary data for the 9th-16th centuries AD for the territory of Alava, with special emphasis on the site of Santa Lucia de Torrentejo, in the village of Labastida (Alava, Basque Country, Spain). In this scope, one of the main objectives of this research will be to define the presence, chronology and consumption patterns, not only for Alava, but also for the region of the upper Ebro Valley (Spain). The methodology will be oriented to identify different production groups and to delimit their origin, using the techno-typological study of the materials corresponding to the stratigraphic context of the Torrentejo site. Finally, the information will be compared with other records in the area of the same chronology in order to see if there are any similar patterns, and to establish connections at larger scales. This research expects preliminary results especially for the ceramic types with a regional diffusion, as it is shown in the only initial studies on glazed, coarse and fine earthenware, which will be presented in this conference. Finally, the diffusion and the chronology will be placed within definite space-time coordinates, so to obtain data for the reconstruction of economic and social history, allowing us to provide new approaches to the society and the present investigation.

Think globally, act locally: global requirements and local transformation in sugar pots manufacture in Sicily in the medieval and post-medieval periods

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Sugar production and consumption followed the Islamic expansion in the western Mediterranean and had a huge impact on European social, cultural and economic development since medieval times. The introduction of sugar cultivation entailed knowledge transfer and new technological requirements, such as the manufacture of sugar pots, used for the crystallization of the sugar, which require specific design, thermal and mechanical properties. The SpotEu project, funded under the Marie Skłodowska-Curie actions, explores the development and impact of sugar production in western Europe through the study of sugar pot manufacture from an interdisciplinary perspective, integrating archaeological and historical

research with material science and material culture approaches in an innovative way. Sugar pots are assessed on a morphological, technological and performance point of view aided by instrumental analysis (Petrography, SEM, XRF, XRD, porosity, mechanical and thermal stress test) and software modelling (FEM). This poster focuses on sugar pots from Sicily, one of the main regions for sugar production in western Europe in the 11th-16th centuries AD. First archaeological and analytical results are presented, revealing different centres of sugar pots production on the island as well as specific choices in the design of the vessels and its properties. This will offer the opportunity to shed light on how craftspeople adapt or transformed their ceramic making traditions in order to face the new product demands from the sugar production industry in the Mediterranean.

Tinkering with Terra Sigillata production: The case of Marzuolo, a Roman rural multi-craft site

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Recent excavations at the Roman rural site of Marzuolo (Tuscany, Italy) revealed a purposely designed, large-scale multi-craft complex. Most strikingly, craft activity included production of terra sigillata pottery (TSI), the Roman empire's iconic table ware, in both an experimental (30/20-10 BC) and a standardised (AD 50-70) phase. While Marzuolo is not the first rural TSI production site discovered in Central Italy, its first production phase is unique, both because of its early date and its experimental nature. Within a larger project examining the site's activities and its place in the Roman rural economy, we undertook an integrated analytical investigation into the production of TSI at Marzuolo. Focusing on both experimental and standardised TSI, 60 pottery samples were subjected to elemental analysis (WD-XRF) and refiring tests, supplemented by petrographic analysis and scanning electron microscopy. Extensive raw material prospection was undertaken in the vicinity of the site, and thirteen clay samples were analysed and compared with the TSI samples. Experimental and standardised TSI were found to have distinct compositions, with the latter much more consistent than the former, also in terms of firing technology. Both groups seem to have similarities with mainly one of the clay samples, although no exact matching has been identified. We discuss the impact of results on our understanding of technological choices involved in TSI manufacture, such as strategies for clay processing and firing, and detail the technical nature of experimentation with TSI production, showcasing how this may have led to the eventual adaptation of a standardised recipe. Besides providing reference data for TSI production in rural Etruria, by examining a crucial phase in the establishment of a pottery production site and of a technological tradition, the present work will contribute to discussions of experimentation, knowledge development and transfer, relevant to ceramic manufacture more widely.

Petrography variability of domestic vessels from Tel Akko

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The subject of the research are ceramics samples from Tel Akko excavations (Galilea, Israel). This case study are focusing in kitchen wears. Tel Akko was inhabited from Early Bronze Age into the Hellenistic period and for centuries was a significant city and port in the region. Currently, excavations in the Tell are carried out since 2010 under the direction of Ann E. Kilbrew. The collection of samples submitted for petrographic analysis is diverse in terms of the type of vessels and their age - this gives possibility to observe the petrographic variability of ceramics. Petrographic studies of ceramic samples from Tel Akko are particularly interesting, they can significantly supplement knowledge about used raw materials and their provenance. Microscopic studies were conducted to examine mineral composition and petrographic features. Polished petrographic preparations were studied with an Olympus AX70 Provis petrographic microscope. So far, the analysis has allowed to separate 4 main petrographic groups. 1. Calcite group (cooking pot, backing tray). Common characteristics: Color: orange, dark reddish gray, background: matrix is optically active, presence of quartz and carbonate silt, inclusions: calcite, quartz, few feldspar. 2. Red group (Bowl, cooking pot, trefoil). Common characteristics: Color red, ferruginous optically active matrix, quartz silt, inclusions: sandy fraction, sub-rounded quartz, few feldspar. 3. Costal group, this group is very wide and contains all types of pottery. Common characteristics: Color: pale red, pale or dark orange, background: carbonatic clay with iron oxides and a lot of microorganism, contains soil balls, inclusions: subangular quartz, limestones. 4. Mica rich group. Common characteristics: Color: brown-red, contains quartz silt, rich in mica, almost lack of temper and sand fraction grains. This petrographic analysis of ceramics fits into significant idea of Tel Akko excavations: documentation of Akko's rich heritage and diversity of its community through centuries.

STATISTICS AND DATABASES IN ANCIENT CERAMIC STUDIES: PAPERS IN HONOUR OF MIKE BAXTER

A Compositional EDMA approach for developing of a typology for the Majolica products from Barcelona

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To present, the classification of ceramics is carried out by heuristic methods based on someone's expertise and the use of analogue catalogues held in archives and libraries. These archives have the classifications currently encoded in drawings and written descriptions. However, in the case of Majolica products there does not exist a general accepted catalogue of types. Traditionally, its classification is based on art history criteria mainly related to decoration. Within the frame of ArchAIDE research project (Archaeological Automatic Interpretation and Documentation of cERamics, European Comission H2020-693548) we are developing a new typology for majolica, focussed on Barcelona area products. The aim is to obtain a digitization that can successfully identify them. Thus, in order for ArchAIDE system to be able to deal with majolica the transformation of the paper and digital publications in a digital description is needed. It requires digitize one by one the drawings of each pottery coming from well-defined archaeological context to be introduced in a geometric 2D description of each ceramic class in the database. To determine these classes is necessary standardize the drawings at the same scale and try to observe similarities and differences in order to define the possible types. This study will use the Compositional EDMA (Euclidean Distance Matrix Analysis) geometric morphometric method to approach the form and/or shape of ceramics, capturing their geometry. This coordinate-free landmark method enables the study of form avoiding the nuisance parameters of translation and rotation, and the study of shape regardless of size.

Correlating Mleiha Pottery

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The site of Mleiha in the emirate of Sharjah, excavated by the French archaeological mission since 1986, offers a stratigraphical pottery sequence which became the chronological reference for the Late-Pre-Islamic period (3rd c BC - 3rd. c. AD) in the Oman peninsula. If most of the wares are conveniently distributed in chronology, their origin and place of production are rarely precisely defined. Establishing groups of potteries statistically correlated, by X-ray fluorescence (XRF) spectrometry analysis, we reduce the variability of the corpus determining larger industries. Then, the specimens of that local database can be compared with sampled industries, well localized, collected in distant sites. This way of working will offer progressively confident determinations of the origin of the main long-distance imports, but also a more precise geography of the circulation of goods across inland Arabia.

Developing an expert system for a preliminary automatic evaluation of chemical and mineralogical data in provenance studies

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Ceramic is one of the most subtle materials forming the archaeological record. This quality, in addition to its frequent occurrence since late prehistoric contexts, have made of it one of the main means to define spatial and chronological series, as well as a valuable indicator of cultural boundaries. At the same time, instrumental characterization of pottery has enabled researchers to tackle problems related to the construction of exchange networks, the material conditions in which technological traditions developed, and to vessels' performance and its role in everyday life. Comparatively, lab-based characterization has also increased exponentially the amount of information produced by archaeological research, creating new necessities to store and process data. Among such efforts we can find the construction of databases integrating statistical analysis for chemical grouping and provenance definition, sometimes shared openly. However, the use of such databases implies some problems. Among other aspects, it cannot be assumed that the composition of archaeological ceramics is always representative of the good's original one. Mineralogical and chemical transformations affect sherds when buried in the soil, which might have implications in provenance and technological interpretation. Those transformations depend on compositional and technological traits and on post-depositional conditions, requiring approaches combining different analytical techniques for their detection. One known alteration process affecting high-fired calcareous pottery (> 6-8 wt% CaO) is analcime crystallization ($\text{NaAlSi}_2\text{O}_6 \cdot \text{N}_2\text{O}$), resulting in Na-enrichment of the ceramic body. Na-zeolite formation is also associated to significant deviations in K and Rb concentrations, which can be erroneously taken as indicative of different clay sources. This paper focuses on the creation of an accessible on-line database combining chemical (X-ray fluorescence) and mineralogical (X-ray diffraction) composition from archaeological ceramics that would be automatically accessed in any evaluation of a new data set. The implementation of automatic routines to identify provenance with already existing meaningful ceramic groups will be able to discriminate post-burial altered samples, like analcime-bearing sherds. Programming languages employed so far are MySQL for database building and R for statistical treatment and data retrieval. The ceramic assemblage employed to test the validity of the system is formed by Roman Terra Sigillata from the Hispania Tarraconensis province.

Sampling strategies via statistical exploitation of morphometric data: Maximizing the assets of petrographic examination for a chronological review at the medieval town of Martorell (Barcelona, Spain)

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Medieval greyware is the most abundant finding at the archaeological site of Santa Margarida (Martorell, Barcelona). It is placed close to the ancient Via Augusta and the most ancient archaeological evidence is an Early Christian church with tripartite apse and its extensive necropolis. During the period between the 6th to the 12th Centuries this site experienced a great transformation in accordance to the surrounding landscape articulation, the origin of the medieval village of Martorell and the refurbishment of the church, transformed into a Romanesque building. A morphometric and petrographic study has been undergone recently in order to address crucial issues with regard to chronological phases of the site. The great homogeneity of greyware potsherds allowed us to develop new sampling strategies according to their morphometric characterization, statistical exploitation and quantitative analysis. Therefore greyware potsherds of four selected silos from different chronological horizons were sampled according to the results of this approach in order to maximize the assets of petrographic examination via optical microscopy. Statistical exploitation of vessel shape compared to macroscopic paste analysis has enabled us to determine more precisely the chronological transformations of pottery at this site and the changing paste recipes. Whilst some high quality boiling pots or ollas were imported from the neighbouring medieval kiln site of Cabrera d'Anoia, medieval Martorell developed a local production of greyware vessels. Our study has been of great importance to identify the local production and to characterize a reference group. These findings open new research perspectives about the daily activities at this site and the greyware pottery production and distribution in Medieval Catalonia.

Statistical approach to pottery quantification as ways to explore chronology, economy and culture of Roman and Late Antique settlements: the case of Artena (province of Rome)

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Since 1995, Roger Lambrechts then Cécile Brouillard and Jan Gadeyne investigate the artificial terrace of the Piano della Civita at Artena, near Rome. The excavations have revealed a complex succession of different phases of occupation that span from the 4th century BC to the 7th century AD. The study of the ceramic assemblages from this site is an integrative part of my PhD dissertation. An important part of the common ware has scarce parallels. Despite the identification of the phases of occupation, the stratigraphy and chronological sequence of the material is difficult to read due to multiple occupations and refurbishments of some buildings as well as soil erosion. These difficulties encountered on the field call for the application of different techniques to apprehend the chronology of the ceramic finds. Therefore, the assemblages (about sixty thousand sherds in stratigraphy) have few usable evidences outside themselves. This paper discusses chronological, cultural and economic data that was extracted from these contexts, based on the assertions of contemporaneity of assemblages with similar features. Our methodology uses statistical tools such as the chi-squared tests and the linked correspondence analyses on types and fabrics to help refine the chronology of these wares. These methods are then used to do comparisons between the ware from Artena and other assemblages to further our knowledge of pottery traditions around Artena, which were fairly different from Rome and other well-known sites in Roman and Late Antique times in terms of economic and cultural patterns. Statistical approaches are rare in studies on Italian ware; even quantifications are uncommon in the recent studies (except for amphora). Therefore, through the case-study of Artena, this paper aims to encourage the development of such techniques as a tool to provide further insights into pottery studies in Central Italy in the Roman and Late Antique periods.

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The Levantine Ceramics Project
(LCP, <https://www.levantineceramics.org>)

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The abundance of pottery recovered from archaeological excavations in the Levant makes it a challenge to share all the information it conveys to researchers worldwide. Print publication is too slow to relay the most current understandings and too rigid to foster interaction. Existing digital initiatives are also problematic: most are static repositories, impossible to update. This problem is not unique to the ancient Levant. The Levantine Ceramic Project website and data base (LCP, levantineceramics.org) offers a new solution. It is a collaborative open access website devoted to ceramics produced anywhere in the Levant—Turkey, Syria, Cyprus, Lebanon, Israel and the Palestinian Authority, Jordan, and Egypt—from anytime between the Neolithic era (c. 5500 BCE) to the end of Ottoman rule (c. 1920 CE). On the site there is data about ceramic wares, petro-fabrics, individual vessels, petrographic analyses, and kilns/workshops. The LCP is open access and is crowd-sourced: anybody may register to become a contributor and submit data, whether already published or newly discovered. Contributors may specify levels of privacy for their submissions from completely private to fully public, and may edit their entries at any time. A scholarly citation can be generated for every LCP page, making all

entries digital publications. The LCP is an ever-growing resource, designed to be both a scholarly archive and an updatable research tool. Eventually it will allow archaeologists to address questions for which ceramics offer basic evidence on new levels, also combining data from various geographic regions and various periods.

