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NAVIGATING IN A SEA OF DATA. TRADE IN THE ANCIENT MEDITERRANEAN

Theme: Mediterranean seascapes

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Format: Regular session

Trade was an essential factor in the construction of inter-community relations around the Mediterranean. Research depends on a limited and evenly sampled series of data that increases gradually as archaeological discoveries continue. The management of all this information involves the creation of databases. These databases must accommodate the complex and fragmented nature of archaeological evidence. They must also be intelligently structured, anticipating the requirements of historical research. Questions can be formulated as long as the databases are correctly tested and accessible. This EAA session proposes a joint discussion of this entire research process, that combines four strands of research: data collection, analysis, interpretation and dissemination.

The interpretation of data depends on documentary sources, the spatial distribution of data points and the wider socio-political understanding. Sources raise questions about the material that has been preserved in the archaeological record. These consist basically of pottery (tableware, flashlights, amphorae, etc.), metals (ingots, coins, etc.) and building materials (marbles, tegulae, laterculi, etc.). The information provided by these objects is increased when they bear inscriptions. Therefore, this session will focus on epigraphic and numismatic studies. Spatial perspectives on supply, transport and distribution areas are also of interest, with attention to ports and trade routes. In this sense, we are especially interested in stamps, tituli picti and graffiti and other inscriptions, but also in concentrations of materials such as wrecks and dumps. Finally, studies on communities and institutions directly related to trade can also provide useful insights, especially, considering lapidary epigraphic databases.

ABSTRACTS

01 AN INTRODUCTION TO THE DATA MANAGEMENT ON ANCIENT TRADE

Author(s): Remesal Rodríguez, José (Universitat de Barcelona)

Presentation Format: Oral

The Mediterranean basin witnessed a dynamic evolution of societies in ancient times. Trade was one of its main causes and consequences, increasing their interdependence. This session deals with the problem of generating and continuing a solid investigation. An investigation that must be based on a large volume of data and formal hypothesis testing. The whole process should be in line with coherent planning. Technological progress and the evolution of research keep this perspective open, with the creation of new databases and the revision of the operational ones. The construction of a database requires the use of protocols for including bibliography and unpublished documents. About this, the CEIPAC's expertise on the management of his amphoric epigraphy database provides a backgrounding model. Nowadays, specialized software and appropriate ontological designs are required for integration into accessible and interconnected online platforms. These databases should allow the application of traditional and emerging analytical methods. Issues such as quantification techniques, network analysis or modelling (using geographic information systems or agent-based modelling) are the natural "next stages". In this sense, historians, physicists, and computer scientists work together in the EPNet project, by developing new approaches on the management of data and the theoretical interpretation of ancient economy.

02 'CASA DA BICA' COIN HOARD RESEARCH FRAMEWORK: DATABASE INFRASTRUCTURE AND KNOWLEDGE EXTRACTION

Author(s): Botica, Natalia - Machado, Diego - Martins, Maria Manuela - Magalhães, Fernanda - Ribeiro, Jorge (University of Minho)

Presentation Format: Oral

The circulation of people and wares inside the roman borders, by land and through Mediterranean and Atlantic shores, stimulated also the circulation of a huge amount of coins needed to trade, to pay taxes and salaries, to build and reform constructions, to import and export materials, products and services between cities, provinces and regions. The study of coins is an important way to access to signs of the economic processes of the classical world in order to identify periods of acceleration or stagnation that leave traces in the quantity and quality of currencies in circulation, which can be evaluated by the monetary treasures or the loose coins found in excavations carried out in urban areas.

During the excavation campaign carried out in 2015 on the surrounding area of the Roman theatre of Bracara Augusta (Braga - Por-

tugal) was identified a hoard composed by 371 bronze coins minted between III and V centuries A.D.

The 2ArchIS digital platform of the Archeology Unit of the University of Minho was used to record this data, using data standards and following proper procedure to guaranteed integration into the archaeological context. This methodology allows us to make quantitative and qualitative analyzes of the data, as well as micro and macro spatial analysis. It also allows the interoperability to external research infrastructures and the easily dissemination and reuse of data to the archaeological research community.

03 TECHNICAL SKILLS TRADE: A MODEL FOR LUNI MARBLE TRAVELLING LABOURERS

Author(s): Bozzi, Chiara (Università Ca' Foscari Venezia)

Presentation Format: Oral

The diffusion of the Luni marble between the 1st and the 2nd century in Italy and in the Western provinces is an important phenomenon in Roman stone trade, considering that its use changed the monumental panorama of cities such as Arles, Autun, Lyon, Narbonne, Nîmes, Cartagena, Córdoba and Tarraco within a few decades. Besides, the analysis of some of these contexts allowed to assume, for some time, that specialized workforce traveled with Luni marble and disseminated the urban decorative tradition in these provinces. In fact, the marble workshops that had formed in conjunction of the major imperial contracts, such as in Rome during the Augustan age, after the end of these building sites turned to other activities, including that of accompany the exported marble. Technical expertise trade is hard for us to consider, because in practice there is a lack of common and shared data collection systems.

The aim of this paper, focused on labour organization, is the creation of a model data sheet in order to identify the work of Italian travelling labourers in the Western provinces, through the examination and the recognition of stylistic and typological elements on marble products. This model would keep into account also the information coming from inscriptions or other hallmarks already studied and investigated. A standard and systematic data collection is the starting point for analyze this phenomenon and its extension. The question is trying to figure out whether this is a common situation or an isolated case of a few contexts. The model data sheet would enable the comparison between different types of information, taking more account of iconographic patterns and stylistic analysis

04 QUANTIFYING ROMAN TRANSPORT IN THE IBERIAN PENINSULA. DEFINING TERRITORIAL CONFIGURATION FROM COSTS AND TIMES OF TRANSPORT

Author(s): de Soto, Pau (Universidade Nova de Lisboa)

Presentation Format: Oral

The analysis of Roman infrastructures to understand the transport costs and the commercial routes and processes is an indispensable way to know the benefits and shortcomings of the transportation system created in Roman times. It is well known that the Roman Empire built the first big transport network. This overwhelming task included not only the construction of roads, but also the building of river ports and maritime harbours. Such a huge effort aimed to create an integrated economy covering all the Roman provinces on the Mediterranean Sea and Atlantic Ocean.

Thanks to the Mercator-e Project, it has been possible to reconstruct the Roman transport conditions by modelling travel costs and times with the help of GIS and Network Science applications. The main geographical focus of this project is the Roman Iberian Peninsula. It was necessary devote a significant effort to gather, document, analyse and digitise the Iberian Roman communications with high precision, creating the first complete road network map. The results of such applications provide us with new information to understand the distribution of commodities, product competition and problems of stagnation in ancient economies such as that of Ancient Rome.

The ability to see graphically and numeral those costs values which until now they could only be guessed, can open new perspectives and justifications to the speeches made on this field until today. In fact, the comparison between these results and the analysis of archaeological and historical interpretations should complement each other, clarifying and offering more elements for a global vision. This project allows us to discover very interesting economic patterns. The results will show how the construction of the Roman complex transport network in the Iberian Peninsula was designed with clear economical purposes.

05 AN ARCHAEOOMETRIC AND EPIGRAPHIC DATABASE ON WINE ROMAN AMPHORAE FROM HISPANIA CITERIOR/TARRACONENSIS

Author(s): Martínez Ferreras, Verónica (ERAAUB, Department of History and Archaeology, University of Barcelona)

Presentation Format: Oral

Epigraphic stamps on wine amphorae from north-eastern Spain have largely been investigated but the debate about their meaning remains still open. They have been attributed to several actors associated with two main activities: 1) the production process, representing the (itinerant) potters who produced the amphorae; 2) the wine trade process, representing the owner of the packaged product, whether as a winemaker, negotiator, or exporter. Peculiarities in specific areas have recently been recognised, suggesting a chrono-spatial evolution of the sealing processes. Nevertheless, epigraphy is somewhat deficient to accurately identify the origin of the stamped amphorae, since some stamps have not been found in any pottery workshop, while others have been recovered in various (nearby or distant) production centres.

This study combines archaeological and archaeometric data on some stamped amphorae found in several pottery workshops, urban

trade centres and shipwrecks. These data have been compared with the CerUB analytical database of the ERAAUB team, which is founded on chemical (through X-ray fluorescence), mineralogical (X-ray diffraction) and petrographic (thin section optical microscopy) analyses of ca. 1400 amphorae from 28 pottery workshops, 15 consumption centres in Tarraconensis, Narbonensis and the limes, and 5 shipwrecks. The aim is to demonstrate the usefulness of a large archaeometric database to investigate provenance and trade of the sealed amphorae. Thus, it has been proved that there is no a univocal relationship between the pottery workshops in which the stamps are found, and their real provenance since the workshops also acquired amphorae produced in other centres. Since the study cases investigated are contextualised in different time periods, the research also provides significant information on the evolution of the production and trade dynamics and sealing practices developed in the region between the mid-1st century BC and the mid-1st century AD.

06 STAMPED AND INSCRIBED AMPHORAE FROM THE ANCIENT SHIPS OF PISA SAN ROSSORE

Author(s): Tescione, Teresa (University of Naples Federico II) - Pace, Gloriana (University of Pisa)

Presentation Format: Oral

The aim of this paper is to present stamps and graffiti on the amphorae found at the archeological site of Cantiere delle Navi antiche di Pisa (Italy).

During the excavation in the area of the railway station of Pisa San Rossore (1998-2014), a deposit with at least 30 shipwrecks was unearthed: this archeological deposit was associated with a watercourse, probably a tributary of the ancient river Auser (actual river Serchio). The ships, some with cargo still on board, were embedded under nine centuries of silt; after some exceptional floods due to intense rain, the Arno river broke its embankments close to a bend and poured out huge quantities of water and sediments in the area of this canal, sweeping away everything and leaving materials in the hollows of the ground. The constant erosion, renewal and movement of the stream bed has been the main catalyst for creating the deposit, but they were also formed by flood water coming from other directions.

The huge amount and variety of findings deposited in the archaeological layers is certainly due to the heavy commercial activities which characterised the area of this harbour from the Late Republican to the Late Roman time.

The research consists on a sampled series of data: stamped and inscribed (tituli picti, graffiti) amphorae found in the alluvial layers, which demonstrate the importance of the Pisa's harbours in the local Thyrrenian and Mediterranean economic sphere throughout the roman centuries.

The information processing depends on data recording in a geographical database which allowed the spatial intra-site distribution of amphorae: in this way, the documentary source could be connected to shipwreck's cargo or context of first provenance, or could be also considered as residuals or intrusives compared to the contexts in which they are placed.

07 RHODIUM VINUM IUCUNDUM. A QUANTITATIVE ANALYSIS OF IMPORTS OF RHODIAN WINE IN THYRRENIAN ITALY BETWEEN 3RD AND 1ST CENTURY BC

Author(s): Tomei, Francesca (Independent researcher)

Presentation Format: Oral

Wine has been largely produced in Rhodes and its territories in Asia Minor since IV century BC until at least II century AD. Stamped amphoras spread all over the Mediterranean and Black Sea are a marker of the diffusion and popularity of Rhodian wine, which was mainly traded with grain from Egypt, Black Sea regions and Sicily.

This paper focuses on imports of Rhodian wine in the main centers of the Thyrrenian coast of Italy during Hellenistic age. I analyzed all Rhodian amphoras well published from archaeological excavations, both on land and underwater, from Etruria to Sicily. Then I collected all information in a database, containing site of provenance, main features of the stamp (if any), such as shape, inscription and symbol, chronology and other relevant information on the amphora examined. I took in consideration also amphoras without stamp or fairly readable in order to get a better quantification of imports. Database enabled me to do statistical analysis to determine chronological trends of imports and the occurrence of particular stamps.

In addition, I linked the database to a GIS software in order to investigate spatial distribution of Rhodian amphoras. GIS let me investigate where in Thyrrenian Italy Rhodian stamped amphoras were more or less numerous, and so where this Greek wine was particularly appreciated.

08 FROM TITULI TO TRADE SYSTEM: AUTOMATED ALGORITHM FOR SYNTACTIC ANALYSIS OF EPIGRAPHICAL MATERIAL

Author(s): Romanowska, Iza (Barcelona Supercomputing Center) - Martín-Arroyo, Daniel (University of Barcelona)

Presentation Format: Oral

Imagine having 2000 inscriptions on roman amphora at your site. Each of them is unique but they do seem to follow some syntactic patterns (for example, "a name, followed by a date, followed by a number"). But how do you make any sense of them? Can these patterns be quantified? Do they group into possible 'cargos' or specific products? How are they related to the location of each amphora sherd within the city?

Here we present a Python-based software tool that compares epigraphic inscriptions to each other using the edit distance measure, calculates clusters based of this similarity and visualises them as cluster maps and dendrograms. It can also look for correlations between the defined clusters and independent variables at different thresholds.

In short, this is a tool that aids the analysis of written sources by quantifying their syntactic similarity and providing visual and statistical methods to aid the interpretation.

To showcase its functionality we applied the edit distance tool to a dataset from Pompeii comprising tituli picti found on amphoras throughout the city. The results show strong differences in the syntactic attributions between the latin and the greek worlds as well as a number of previously unknown spatial patterns.

09 MAURETANIA TINGITANA. A REVIEW OF AN ATLANTIC PROVINCE

Author(s): Pérez González, Jordi - Pons Pujol, Lluís (Universitat de Barcelona)

Presentation Format: Oral

It has already been more than a decade since Lluís Pons defended his doctoral thesis (2003), where he dealt with the economy of the province, with a particular focus on the peculiarities of the food supply of the province (imports and exports of olive oil, wine and salted fish). Ever since, both the scientific production of the province, with the inclusion of new data, as well as the progress in the different methods of analysis, allows us to approach the subject again, redefining some aspects of the economic and social history of the Mauretania.

To know the distribution of food between Mauretania and the rest of Roman provinces we have used the study of ceramic containers. In this sense, the analysis of the stamped amphorae allows us to know the provenance and the estimated date of the contained foods, basic to examine the different dynamics to which the province was subject. For current research, the distribution of stamps throughout the European space is the fundamental element that allows trade networks to be established between Baetica and other regions of the Roman Empire. We must not forget that the epigraphy of the province represents a small percentage of all the amphoric material known in the Roman Empire.

In order to carry out the following analyzes, we have used the information collected in the CEIPAC online database. In this sense, the incorporation of novel methods of analysis that allow us to approach the data from a new point of view is of interest.

10 THE MARKINGS OF THE TRADE: EXPLORING THE PATTERNS OF OLIVE OIL PRODUCTION IN ROMAN BAETICA

Author(s): Coto-Sarmiento, Maria (Barcelona Supercomputing Center) - Rubio-Campillo, Xavier (University of Edinburgh) - Remesal, José (University of Barcelona)

Presentation Format: Oral

The aim of this study is to detect the patterns of olive oil production that link amphora workshops and amphoric stamps. Roman provinces such as Baetica became important production and distribution centers during the Roman Empire. However, it remains under debate how this province was organized and whether it is possible to identify patterns in the olive oil market.

Our case of study has been focused on the production processes located in Baetica province (currently Andalusia) from 1st to 3rd AD. In particular, we want to explore economic dynamics that include the production and distribution of olive oil trade. Amphoric stamps are used to identify the presence of different producer groups that might share similar stamps. To achieve this goal, we analyse a set of stamps from different workshops in Baetica province in order to detect a relation between the distribution of amphoric stamps and the economic structure in this province. Here we use methods borrowed from Ecology that allow us to identify if these amphora workshops share similar amphoric stamps depending on the spatial distance.

The analysis explores how quantitative approach provides a useful tool for the interpretation of the economic processes. Finally, results pretend to highlight the organization of olive oil production in the Roman Empire linked to the differences observed in the archaeological evidence.

11 IDENTIFYING LONG-RANGE CONNECTIVITY WITHIN THE ROMAN EMPIRE THROUGH ARCHAEOLOGICAL PROXIES

Author(s): Rubio-Campillo, Xavier (The University of Edinburgh)

Presentation Format: Oral

The creation of the Roman Empire promoted the connectivity of a large area around the Mediterranean sea. While several works have explored the dynamics of interaction in specific case studies there is no consensus on the level of connectivity between the provinces.

The last years have seen an improvement on the availability of evidence as a growing amount of datasets is collected and published. However, the availability of new datasets also means that we need to deal with the challenges posed by this evidence, including the presence of biases and high levels of uncertainty. Moreover, data does not equal knowledge and the methods used to analyse this evidence has not advanced at the same pace.

We present here a new framework designed to identify large-scale connectivity through the use of similarity indices. The amphora

stamps collected over more than a thousand sites across the Roman Empire have been analysed using quantitative measures of similarity. The patterns that emerge from the analysis highlight the intense connectivity derived from factors such as the spatial closeness, presence of military units and the relevance of the Atlantic sea as a main shipping route. We believe that these findings will not only help understand these dynamics but the suggested approach will highlight the need for statistical hypothesis testing in the study of past economies.

a. COINS IN THE MARITIME ROMAN COLONY OF CASTRUM NOVUM. CONTRIBUTION TO UNDERSTANDING OF TRADE AND GLOBALIZATION OF THE MEDITERRANEAN SEASCAPE

Author(s): Paclíková, Klára - Vuono, Magda - Preusz, Michal (Department of Archaeology, Faculty of Arts, University of West Bohemia in Pilsen) - Enei, Flavio (Museo Civico di Santa Marinella) - Caponetto, Paolo - Fantozzi, Bruno (Gruppo archeologico del territorio Cerite)
Presentation Format: Poster

Archaeological site Castrum Novum is located right on 64.4 km of Via Aurelia, in the municipality of Santa Marinella, in central Italy. This Roman colony was founded in the third century BC at location that was the original Etruscan settlement. The reasons for and the exact period of its abandonment are so far unknown. The available archaeological evidence confirms that the settlement disappeared during the fifth century AD. The site became the object of archaeological research during the second half of the eighteenth century. Pope Pius VI financed the research of valuable artefacts that were intended to increase the collections of the Vatican Museums. Some of them have comprised a part of the collections up until now. After various stages of rescue excavations that alternated with the activities of illegal treasure hunters during the last century, systematic research returned to this site in 2010.

Long-term research brings to light hundreds of findings. The coins belong to the most important. Modern databases in combination with GIS and tools of geospatial science enable to unravel trade contacts of Castrum Novum. Concurrently, it is possible to observe how the relationships between the Romans and the surrounding populations have changed over time. Spatial analyses, related to the coins, are not only a tools for study its distribution in the research area, but especially for study of functionality of archaeological components. Moreover, they explain the process of Mediterranean seascape globalization. Collection of coins from maritime colony consist exemplars from Europe, Africa and Asia.

b. VETUSTATE CONLAPSUM. EPIGRAPHIC TESTIMONIES OF REPAIR OF ROADS AND OTHER PUBLIC INFRASTRUCTURES IN ROMAN HISPANIA (1ST - 4ST CENT. AC)

Author(s): Sánchez de la Parra Pérez, Santiago (HESPERIA Research Group. Department of Prehistory, Ancient History and Archaeology. University of Salamanca - USAL)
Presentation Format: Poster

This work approaches the study of interventions of classic era destined to the rehabilitation of Hispanic public works through the Latin epigraphy. Inscriptions gather the origin of the funding of the works, their dating, the reasons for its restoration...

The use of formulas such as *vetustate conlapsu restituit* or *renovatae a solo* allow to find out the reason and the volume of the repair. Additionally, we also compare the content of the inscription, the formal characteristics of its support and the context of its finding with the archaeological data available on the repaired infrastructures. Working with information of diverse nature requires designing a database to collect and relate it properly. Thus, we will check if the epigraphic information coincides with the archaeological remains.

There is a diversity of repaired constructions. Many inscriptions collect the intervention on roads and bridges. This type of work, financed by the imperial administration, is referenced in milestones of very different times. The development and maintenance of these infrastructures were essential in all the provinces of the Empire, since they facilitated the communication, the relations between geographically very distant cities and the terrestrial trade. Latin epigraphy also reveals the interest of local elites to repair other public works with less representation in the sample.

We can identify general guidelines in the repairs taking into account the chronology of the epigraph, its support, the type of work performed and the origin of the financing. We intend to provide information about the interest of the imperial administration in the maintenance of road infrastructures in specific areas and the significance of public works restored in the urban areas of Hispano-Roman cities.

c. THE ARCEA PROJECT

Author(s): Mateo Corredor, Daniel - Álvarez Tortosa, Juan Francisco - Santana Onrubia, Rubén - Molina Vidal, Jaime (University of Alicante)
Presentation Format: Poster

Over the last years, the scientific community has shown a great interest in the studies focused on the production and trade of Roman amphorae in ancient Hispania, as evidenced by projects such as CEIPAC, Amphorae ex Hispania or Amphora Project. However, the advances in the knowledge of Hispanic amphorae productions have been uneven, being Tarraconensis northern coast and Baetica the best identified areas. On the contrary, amphorae production of the Tarraconensis central coast is less known, despite the fact that these containers would be traded in the western empire, as shown by classic authors' references such as Juvenal and Fronto and the amphorae findings in Rome. For this reason, a research program has been started which intends to improve the knowledge

of this production and its distribution, the ARCEA project, "Production centres and trade relations in the Early Empire. Analysis of the amphorae production of the Tarraconensis central coast", funded by the University of Alicante. One of the actions developed within this project has been the analysis of the cargo of the Mariposa E shipwreck, found in Alghero coast (Sardegna, Italy). This shipwreck transported Dressel 2-4 amphorae which origin from the area of Tarraconensis central coast is proposed. Moreover, field surveys and the excavation of the production centre of La Rana (Gata de Gorgos, Alicante) have been carried out. Finally, a program of typological revision, archaeometric characterisation and epigraphical analysis of the central Tarraconensis amphorae is already initiated. First results of the project are presented.

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