VESSELS INSIDE AND OUTSIDE

EMAC'07

9TH EUROPEAN MEETING ON ANCIENT CERAMICS

OCTOBER 24-27, 2007

BUDAPEST, HUNGARY

PROGRAM AND ABSTRACTS

Organising Institutions

Hungarian National Museum

with the help of

Archaeocomp Association
Institute of Nuclear Techniques Budapest University of Technology and Economics
Eötvös Loránd University of Sciences, Department of Archaeometry and Archaeological Method
Eötvös Loránd University of Sciences, Institute of Geography and Geology
Field Service for Cultural Heritage
Hungarian Archaeological and Art History Society, Archaeometry Workshop
Hungarian Geological Society
Institute for Geochemical Research, HAS
Vienna Institute of Archaeological Science, University of Vienna
Zala County Museum Directorate

EMAC'07 - 9th European Meeting on Ancient Ceramics. Program and Abstracts

Edited by K.T. Biró, V. Szilágyi and A. Kreiter

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CONTENTS

PREFACE

Pottery is one of the basic sources of archaeological inquiry. Ceramic typology and stylistic study of pottery has been, for long time, the main tool for temporal and spatial ordering, classification of people and cultures through the vessels they use. EMAC is devoted to ceramic studies beyond the form and concerned with the technological characteristics of vessels. For the investigation of such questions various methods of scientific analyses are applied ranging from routine laboratory practice to the application of sophisticated analytical techniques.

The series of EMAC conferences started in Rome in 1991. Since its first meeting it has been hosted by various research centres important in the archaeometrical study of ancient - archaeological and historical - pottery.

Hungarian research joined the EMAC meetings in 1999 in Athens. Ever since, Hungarian participation increased continuously and by now a new generation of young scholars is ready to widen the scope of investigations devoted to the most numerous and in many ways most important source of archaeological information.

The main topics of the conference covers, in accordance with former EMAC practice:

- methodological development in pottery studies
- production, distribution, trade
- dating pottery
- pottery as container
- ceramics as building materials
- industrial/technical ceramics
- ceramics in conservation (deterioration, preservation methods and analyses)
- slips and glazes

Considering the special directions of Hungarian ceramic research, a special topic is announced in respect of geological and petrographic approach to the study of pottery.

The host of the meeting is the Hungarian National Museum. Our work was supported by a very active Local Organisation Committee and we received valuable help from the International Scientific Committee as well.

Home institutions of LOC members as well as further centres of archaeological and archaeometrical research also contributed to the organisation of the current meeting. We are also indebted to sponsors and supporters of the conference.

We hope that the meeting will promote pottery studies on a wide scale and also hope to provide participants with lasting and pleasant memories of Budapest and Hungary.

Katalin T. Biró

CONFERENCE OVERVIEW

Tuesday 23rd of October

12:00-18:00	Registration and welcome reception

Wednesday 24th of October

9:00-9:20	Opening
9:20-10:20	*Section 1:* Methodological development (L01-03)
10:20-10:40	Coffee break
10:40-12:00	*Section 1:* Methodological development (L04-07)
12:00-13:00	Lunch break
13:00-14:20	*Poster session 1* (sections 1, 3-8, 10)
14:20-15:40	*Sections 1&2:* Methodological development (L08-09) Production, distribution, trade (L10-11)
15:40-16:00	Coffee break
16:00-17:20	*Section 2:* Production, distribution, trade (L12-15)
19:00	Workshop (meeting point: HNM garden)

Thursday 25th of October

9:00-10:20	*Section 9:* (Theme section) Petrographic aspects to the study of pottery (L16-19)
10:20-10:40	Coffee break
10:40-12:00	*Sections 9&5&6:* (Theme section) Petrographic aspects to the study of pottery (L20-21) Ceramics as building materials (L22) Industrial/technical ceramics (L23)
12:00-13:00	Lunch break
13:00-14:20	*Poster session 2* (sections 2, 9)
14:20-15:40	*Sections 3&4:* Dating pottery (L24-25) Pottery as containers (L26-27)
15:40-16:00	Coffee break
16:00-17:20	*Section 8:* Slips and glazes (L28-31)
19:00	Conference dinner (meeting point: HNM garden)

Friday 26th of October

9:00-10:20	*Sections 8&2:* Slips and glazes (L32-34) Production, distribution, trade (L35)
10:20-10:40	Coffee break
10:40-12:00	*Section 2:* Production, distribution, trade (L36-39)
12:00-13:20	Lunch break
13:20-15:00	*Section 2:* Production, distribution, trade (L40-43)
15:00-15:30	Coffee break
15:30-17:00	Closing/Evaluation

Saturday 27th of October

8:00	Post-conference excursions

PROGRAM

Tuesday 23rd of October

12:00-18:00	Registration and welcome reception *at the building of the Hungarian National Museum* *(Múzeum krt. 14-16.)*

Wednesday 24th of October

9:00-17:20		Conference *at the building of the Hungarian National Museum* *(Múzeum krt. 14-16.)*
9:00-9:20		Opening *Opening address by Dr. László Borhy, Eötvös Loránd University of Sciences, Department of Archaeology*
		Section 1: Methodological development *Chairman: Waksman Y.*
9:20-9:40	*L01*	***Kreiter A., Bajnóczi B., Sipos P., Szakmányi Gy., Tóth M.:*** Ceramic technological tradition: what for?
9:40-10:00	*L02*	***Fabbri B., Gualtieri S.:*** Coarse ceramics with calcite inclusions: a technology for all ages
10:00-10:20	*L03*	***Greene A., Hartley, Ch.:*** (Re)Discovering Ceramic Structure: A Multi-scalar Approach to Understanding Ancient Ceramic Practices
10:20-10:40		Coffee break
		Section 1: Methodological development *Chairman: Starnini E.*
10:40-11:00	*L04*	***Hein A., Müller N., Kilikoglou V.:*** Great Pots on Fire: Thermal properties af archaeological ceramics
11:00-11:20	*L05*	***Nodari L., Russo U., Bertoncello R.:*** Design, development and testing of a transportable Backscattering Mössbauer Spectrometer for ceramic surface analyses
11:20-11:40	*L06*	***Králik M., Hložek, M.:*** Neolithic miniature ceramic vessels - production of children?

11:40-12:00 *L07* ***Mara H., Trinkl E., Kammerer P., Zolda E.:***
3D-Acquisition of Attic Red-Figured Vessels and Multi-Spectral Readings of White-Ground Lekythoi of the Kunsthistorisches Museum Vienna for the new CVA Volume

12:00-13:00 Lunch break

13:00-14:20 *Poster session 1* (sections 1, 3-8, 10)

Sections 1&2: Methodological development
Production, distribution, trade
Chairman: Bezeczky T.

14:20-14:40 *L08* ***Herold H.:***
Vitrification and optical isotropy/anisotropy of matrix in relation to firing temperature on the example of the so called "polished yellow ceramics" of the Carolingian Period (9th c. AD)

14:40-15:00 *L09* ***Daszkiewicz M., Schneider G., Bobryk E.:***
Grog or clay lumps, added or natural inclusions?

15:00-15:20 *L10* ***Muntoni M.I., Eramo G., Laviano R.:***
Serra d'Alto Neolithic ware in the IV millenium BC of Southern Italy

15:20-15:40 *L11* ***Kibaroğlu M., Satır M., Işikli M.:***
The New Searches for Kura-Araxes Cultural Complex : The Petrographic and Geochemical Analysis of Sos Höyük Kura-Araxes Ceramics

15:40-16:00 Coffee break

Section 2: Production, distribution, trade
Chairman: Martinón-Torres M.

16:00-16:20 *L12* ***Odriozola, C.P., Valera A.C., Dias M.I., Pérez V.H.:***
Bell Beaker production and consumption alongside Guadiana River: an Iberian perspective

16:20-16:40 *L13* ***Day P.M.:***
Constructing a Ceramic World: evidence for production, exchange and consumption in an Early Minoan village

16:40-17:00 *L14* ***Ionescu C., Ghergari L., Hoeck V., Simon V.:***
Firing transformations of mineral phases in Late Bronze Age ceramics from Transylvania (Romania)

17:00-17:20 *L15* ***Tschegg C., Hein I., Ntaflos T.:***
Bichrome Wheelmade Ware: Origin and Reproduction

19:00 Workshop on principal questions of pottery archaeometry entitled "Pottery analysis – why and whom?"
at White Peacock (Fehér Páva) restaurant
Üllői út 7.

Thursday 25th of October

9:00-17:20 Conference
at the building of the Hungarian National Museum
(Múzeum krt. 14-16.)

Section 9: (Theme section) Petrographic aspects to the study of pottery
Chairman: Day P.M.

9:00-9:20 *L16* ***Barone G., Belfiore C.M., De Francesco A.M., Laviano R., Mazzoleni P., Montana G., Muntoni I.M., Pezzino A., Triscari A.:***
Clayey raw materials database as a tool for individuation and knowledge of ancient ceramic production in Southern Italy and Sicily

9:20-9:40 *L17* ***Vince A.:***
Pottery supply over three millennia: petrological and geochemical ceramic characterization at Melton, East Yorkshire, UK

9:40-10:00 *L18* ***Nodarou E., Iliopoulos I., Papadatos Y.:***
Technologies in transition: analytical research on Final Neolithic/Early Bronze Age pottery from Kephala Petras, East Crete, Greece

10:00-10:20 *L19* ***Jorge A., Day P.M., Dias M.I.:***
Technological choices at the onset of the Iberian Bronze Age: an integrated approach to ceramics of the Mondego Plateau, Portugal

10:20-10:40 Coffee break

Sections 9&5&6: (Theme section) Petrographic aspects to the study of pottery
Ceramics as building materials
Industrial/technical ceramics
Chairman: Balla M.

10:40-11:00 *L20* ***Kiriatzi E., Siddall R.:***
Rich in Silver' Pots: Sources and Circulation Networks of Coarse Red Silver Micaceous fabrics in Bronze Age SW Aegean

11:00-11:20 *L21* ***Bezeczky T., Mange M.A.:***
New petrographic data on the late phase of the Laecanius workshop

11:20-11:40 *L22* ***Starnini E., Szakmány Gy.:***
Besides vessels: investigating Early Neolithic fired clay artefacts from Hungary

11:40-12:00 *L23* ***Martinón-Torres M.:***
Professional tools in unprofessional hands: assaying crucibles in early colonial America

12:00-13:00 Lunch break

13:00-14:20 *Poster session 2* (sections 2, 9)

Sections 3&4: Dating pottery
Pottery as containers
Chairman: Dias I.

14:20-14:40 *L24* ***Blain S., Guibert P., Lanos Ph., Dufresnes Ph., Sapin Ch., Baylé M., Bouvier A. :***
The church of Notre-Dame-Sous-Terre (Mont-Saint-Michel, France), a case of ceramic building material dating applied to early medieval building archaeology

14:40-15:00 *L25* ***Price D.M.:***
Early discovery of the Great Southern Land 250 years before Captain Cook's epic voyage

15:00-15:20 *L26* ***Müller N., Kilikoglou V., Day P.M., Hein A.:***
The influence of temper on performance characteristics of cooking ware ceramics

15:20-15:40 *L27* ***Zhushvhikhovskaya I.:***
Pottery functions and subsistence pattern in Prehistory (Russian Far East as a Case of Study)

15:40-16:00 Coffee break

Section 8: Slips and glazes
Chairman: Pérez-Arantegui J.

16:00-16:20 *L28* ***Reillon V., Berthier S.:***
The optical properties of lustres and their spatiotemporal evolution

16:20-16:40 *L29* ***Pace M., Bianco Prevot A., Mirti P.:***
Colour, morphology and composition of Parthian and Sasanian glazed pottery

16:40-17:00 *L30* ***Marzo P., Laborda F., Pérez-Arantegui J.:***
Ceramic production in Islamic small kingdoms (Taifas) of the Iberian Peninsula: the case of albarracin (Teruel), 11th-12th centuries AD

17:00-17:20 *L31* ***Pacheco C., Chapoulie R., Dooryhee E., Aucouturier M., Bouquillon A., Makariou S., Miroudot D.:***
Gilded Medieval Islamic glazed ceramics: production process and evolution in the Iranian World (12th-13th c.) and the Timurid Empire (14th-15th c.)

19:00 Conference dinner
at Manor-House (Udvarház) restaurant
Hármashatárhegyi út 2.

Friday 26th of October

9:00-14:40 Conference
at the building of the Hungarian National Museum
(Múzeum krt. 14-16.)

Section 8&2: Slips and glazes
Production, distribution, trade
Chairman: Kilikoglou V.

9:00-9:20 *L32* ***Roqué J., Molera J., Vendrell-Saz M., Pérez-Arantegui J.:***
Lustre and lustre technology in Spain - Comparison between ancient productions from Paterna (Olleries Xiques 13 to 15th centuries) with modern artesian productions

9:20-9:40 *L33* ***Maggetti M., Morin D., Serneels V., Neururer Ch.:***
High-Mg faiences from Granges-le-Bourg (Haute Saone, France)

9:40-10:00 *L34* ***Ricciardi P., Colomban P.:***
Non-destructive characterization of Capodimonte and Buen Retiro porcelain glazes by means of Raman spectroscopy

10:00-10:20 *L35* ***Taubald H.:***
Archaeometrical analysis of Neolithic pottery and comparison to potential sources of raw materials in their immediate environment - an overview

10:20-10:40 Coffee break

Section 2: Production, distribution, trade
Chairman: Taubald H.

10:40-11:00 *L36* ***Eramo G., Laviano R., Muntoni I.M. :***
Late-Republican Grey Ware from Basilicata and Apulia (Southern Italy, 2nd-1st century BC)

11:00-11:20 *L37* ***Vila Socias, Ll., Buxeda i Garrigós J., Kilikoglou V.:***
Roman amphorae around the change of era: production and consumption patterns in the North-East of the Iberian Peninsula

11:20-11:40 *L38* ***Madrid i Fernandez M., Buxeda i Garrigós J.:***
Does low quality relate necessarily to local productions and limited trade? The terra sigillata "A production" from the Naples Bay

11:40-12:00 *L39* ***Dias M.I., Viegas C., Gouveia M.A., Marques R., Franco D., Prudencio, M.I. :***
Geochemical fingerprinting of Roman pottery production from Manta Rota kilns (Southern Portugal)

12:00-13:20 Lunch break

Section 2: Production, distribution, trade
Chairman: Maggetti M.

13:20-13:40 *L40* ***Holmqvist V.E.:***
Ceramic production traditions in the late Byzantine-early Islamic transition: A comparative analytical study of ceramics from Palaestina Tertia

13:40-14:00 *L41* ***Waksman Y.S., Capelli C., Treglia J.-C., Gragueb Chatti S., Rammah M., Cressier P.:***
Ceramics production in medieval Ifriqiya: local productions and foreign influences as seen in the case of Sabra al-Mansuriya

14:20-14:40 *L42* ***Montana G., Iliopoulos I., Polito A.M., Randazzo L.:***
The Majolica production of Northern-Central Sicily (16th-18th century AD): archaeometric evidence

14:40-15:00	*L43*	***Szilágyi V.:*** Inka Ceramic Manufacture: Imperial standardization, local particularity and importation
15:00-15:30		Coffee break
15:30-17:00		Closing/Evaluation *by M. Maggetti and K. T. Biró*

Saturday 27th of October

8:00	Post-conference excursions *Buses start at 8:00 from the Museum Garden (Múzeum krt. 14-16.)*

Posters

Section 1	Methodological development
Section 2	Productiondistributiontrade
Section 3	Dating pottery
Section 4	Pottery as containers
Section 5	Ceramics as building materials
Section 6	Industrial/technical ceramics
Section 7	Ceramics in conservation
Section 8	Slips and glazes
Section 9	Theme section: petrographic aspects to the study of pottery
Section 10	Miscellania

Poster session 1 - 24th of October (Sections 1, 3-8, 10)
Poster session 2 - 25th of October (Sections 2, 9)

Section	*Nr.*	
1	*P01*	***Amadori M.L., Levi S.T., Raffaelli G.:*** The non homogeneous raw materials in protohistoric pottery: the Imola case study compared with other production
1	*P02*	***Baranowski M., Bobryk E., Daszkiewicz M., Schneider G., Schreiber J.:*** Possibilities and limitation of macroscopic determination of pottery fabrics in the field
9	*P03*	***Guzowska M., Pintér F.:*** Imported ceramics at Troy in the 2nd millennium BC – microscopic analysis
1	*P04*	***Hoeck V., Ionescu C.:*** Electron microprobe analysis for archaeoceramics
1	*P05*	***Ikäheimo J.P., Pena Th.:*** The Palantine East Pottery Project: A Holistic Approach to the Study and Publication of an Excavated Pottery Assemblage from Rome
1	*P06*	***Kasztovszky Zs., Biró K.T., Gherdán K., Sajó-Bohus, L.:*** Applicability of Prompt Gamma Activation Analysis to the archaeometry of pottery
1	*P07*	***Kockelmann W.:*** How useful is neutron diffraction for studying archaeological ceramics?

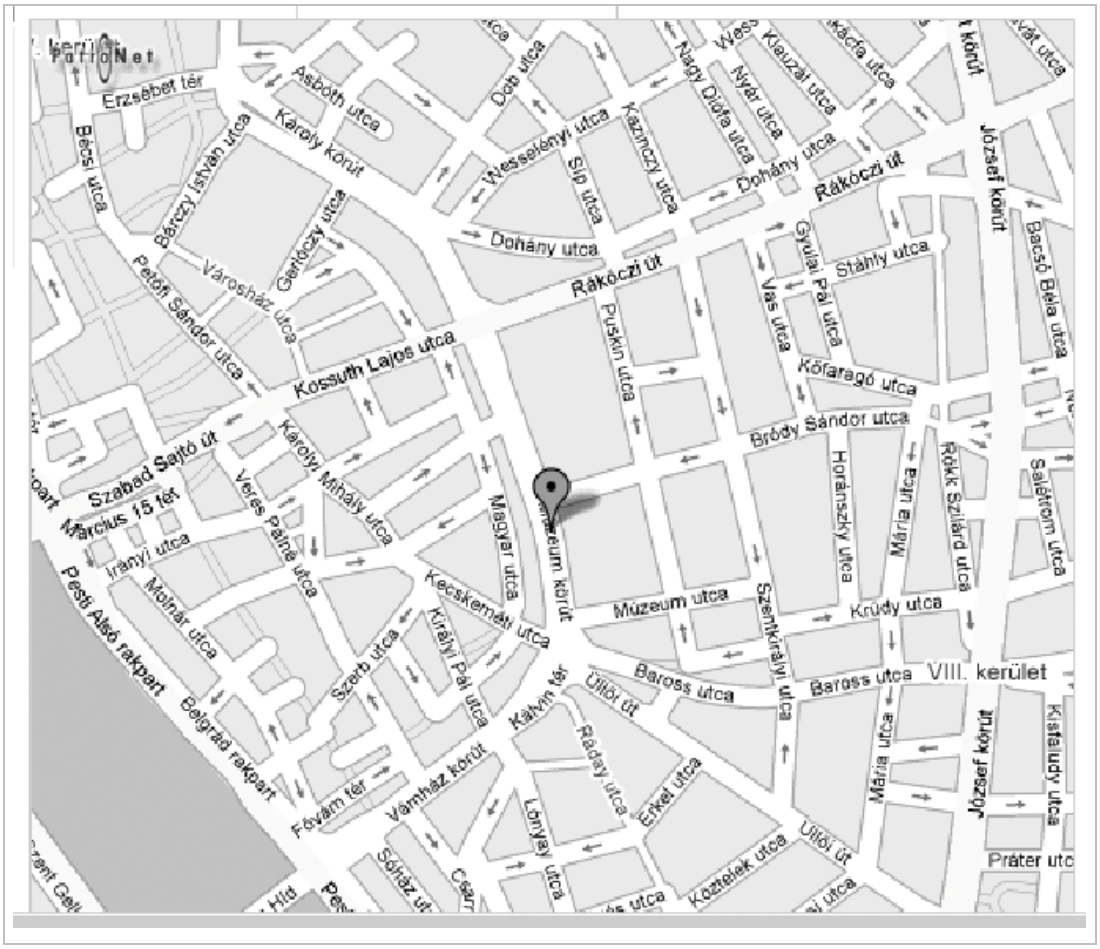
Section	*Nr.*	
1	*P08*	***Mihály J., Veres M., Tóth A., Tóth Zs., Ilon G.:*** Vibrational spectroscopic study of Late Neolithic painted ceramics from Szombathely-Oladi plató (Western Hungary)
1	*P09*	***Niknami K.A., Bahranipur H.:*** A multivariate technique to analyze stylistic variations in the pottery assemblage - case study from an Iron Age cemetery of Sarm, North Central Iran
1	*P10*	***Olcese G.:*** A new database of ancient pottery produced in Italy
1	*P11*	***Tanevska V., Kuzmanovski I., Grupče O., Minčeva-Šukarova O.:*** Determination of the provenance of Vinica terra cotta icons using support vector machines
1	*P12*	***Trindade, M.J.F., Dias M.I., Rocha F., Coroado J., Prudencio M.I.:*** Comparison of mineralogical transformations by firing calcite and dolomite rich clays, used as raw materials for ancient ceramic production in Algarve region, Portugal
2	*P13*	***Ambrosini L., Felici A.C., Fronterotta G., Piacentini M., Vendittelli, M.:*** Non destructive analysis of a red figure vase of uncertain attribution from Falerii Veteres
2	*P14*	***Botti A., Sodo A., Ricci M.A.:*** Byzantine kilns of Southern Italy: an archaeometric look
2	*P15*	***Brodà Y., Cardarelli A., Cannavò V., Levi S.T., Pellacani G., Pulini I., Marchetti Dori S., Zanasi C.:*** Experimental Archeology: Bronze Age Pottery Production in Terramare (Northern Italy)
2	*P16*	***Geba M., Vornicu N., Bibire C.:*** Characterization of ancient ceramics by physical-chemical analysis
2	*P17*	***Grifa C.,Langella A., Morra V., Soricelli G.:*** A post 79 A.D. common ware production from Pompeii (Italy)
2	*P18*	***Gualtieri S., Fabbri B., Ercolani G.:*** Post-depositional formation of macro-pores and secondary filling in Neolithic pottery

Section	*Nr.*	
2	*P30*	***Schubert C.:*** Provenance studies on Trojan Late Bronze Age fine wares from Troy and it's neighbourhood using Neutrn Activation Analysis (NAA)
2	*P31*	***Svoboda V., Vuković J.:*** Pottery Technology of Vinča: Provenance and Characterization of raw materials and Experimental research
2	*P32*	***Van Wersch L., Mathis F., Bouquillon A.:*** Characterization of the Merovingian pottery from productions centres in the Mosan Valley
2	*P33*	***Varvara S., Fabbri B., Gualtieri S., Ricciardi P., Gligor M.:*** Neolithic pottery from Alba Iulia - Lumea Noua and Limba archaeological sites in Transylvania (Romania): composition and technological aspects
4	*P34*	***Cottica D., Mazzocchin G.A.:*** Pottery and pigment from the I.E. excavations in the forum of Pompeii
4	*P35*	***De Sena E.:*** New insights into the supply of wine and olive oil towards Rome: evidence from the École Francaise de Rome Chateau d'eau Project at Ostia Antica
4	*P36*	***Olcese G., Thierrin-Michel, G.:*** Graeco-Italic amphorae in the region of Ostia: archaeology and archaeometry
4	*P37*	***Turcanu S.:*** The Symbolic Meaning of Some Ceramic Items of Rough Paste Belonging to the Precucuteni-Cucuteni-Ariuşd-Tripolie Eneolithic Cultural Complex
4	*P38*	***Vuković J.:*** Functional Analysis of Pottery from the Early Neolithic site of Blagotin, Central Serbia
5	*P39*	***Capelli C., Cabella R., Lavagna R., Piazza M., Ramagli P.:*** Mineralogical and petrographic analyses of tiles from the Late Roman necropolis of Priamar, Savona (Liguria, NW Italy)

Section	*Nr.*	
8	*P51*	***Tanevska V.,Piccardo P., Colomban P., Grupče O., Minčeva-Šukarova B.:*** Characterization of Byzantine glazed ceramic finds in republic of Macedonia by μ-Raman spectroscopy and scanning electron microscopy
8	*P52*	***Veiga J.P., Silva T.P., Figueiredo M.O.:*** Coordination environment of lead in coloured glazes from ancient tiles: an EXAFS approach through the Pb L3-edge
8	*P53*	***Wen R., Pollard A.M.:*** Comparative Study on Blue Pigment of Blue and White porcelain and Islamic Glazed Pottery 12^{th}-17^{th} century
9	*P54*	***Boileau M.-C., Tartaron T., Sarri, K.:*** Local pottery and interregional exchange in Middle Helladic Boeotia: the evidence from Orchomenos
9	*P55*	***Gregor M., Čambal, R.:*** Mineralogical and petrographical study of Celtic household ceramic from Bratislava's oppidum (Slovakia)
9	*P56*	***Precup C., Ionescu C., Hoeck V., Ghergari L.:*** Bronze Age pottery from Transylvania (Romania): a mineralogical study
9	*P57*	***Vrydaghs, L.:*** Phytolith analysis of ceramic thin section
10	*P58*	***Lebegyev J.:*** Vases for children in Mycenaean Greece
7	*P59*	***Dúzs K.:*** Conservation and technology: observations on the Vörs-Máriaasszonysziget pottery assemblage

GENERAL INFORMATION ON VENUE

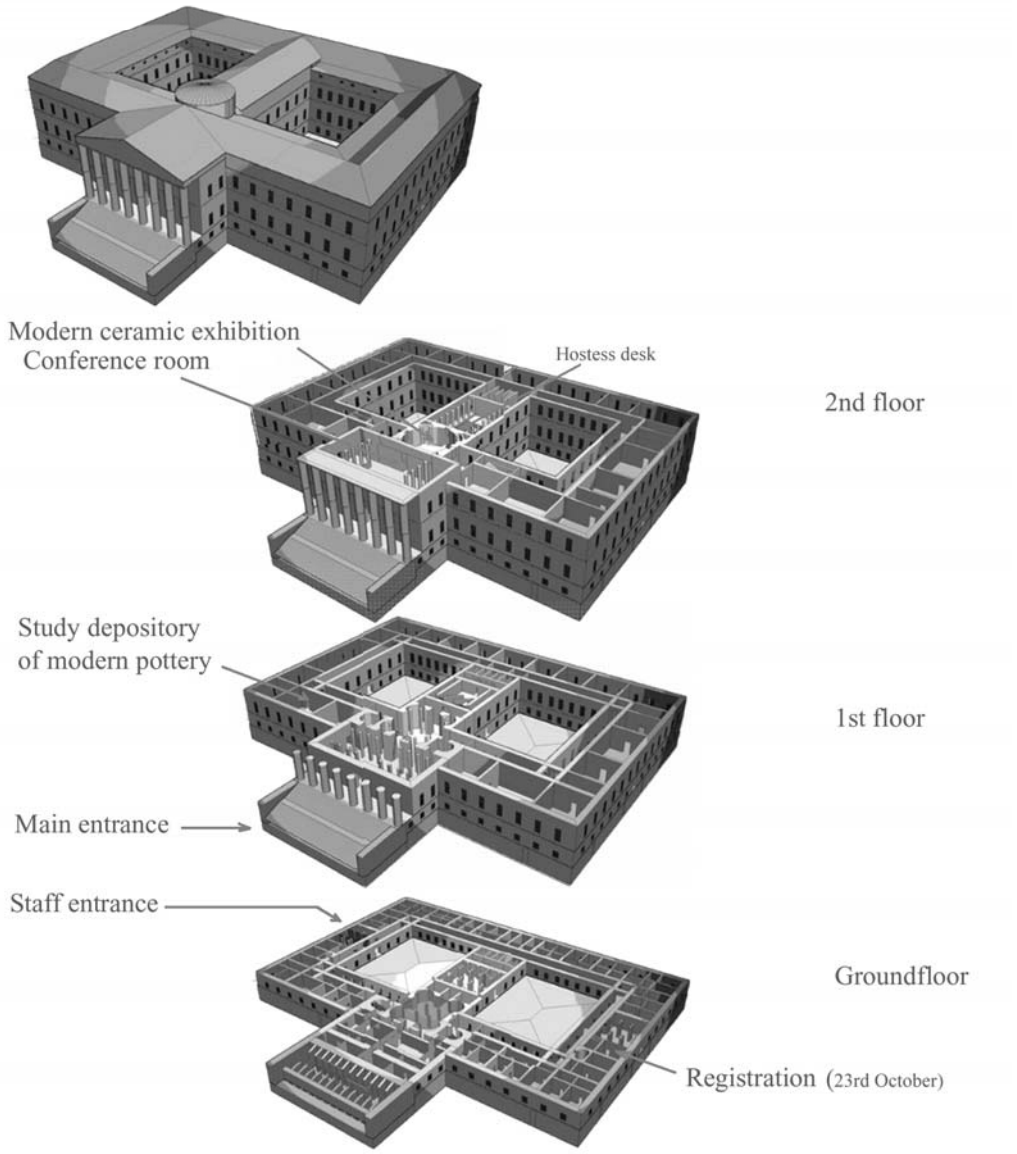
The Hungarian National Museum is situated in the city centre on the Pest side of Budapest. Enclosed you find a map of the immediate surroundings of the Museum - more maps on our website.



During the time of the Conference, construction works will be on Kálvin square, so public transport will be out of regular order. The best way to come to the Museum is by Metro line 2 (get off at Astoria) or line 3 (get off at Kálvin square). Buses (black) 7 and 9 as well as buses substituting trams 47-49 are also convenient.

You can park in the Museum Garden, but for this, we have to arrange permissions.

The building of the Museum can be approached on the main entrance between 10,00-18,00 hours daily on regular opening days. There is permanent porter's service on the Northern side of the building (Gate facing at Bródy Sándor street). Our hostesses will help you find the way and we are enclosing here maps of the museum topography with conference related premises. Smoking is only allowed outside the building - on the museum yards or in the garden.



As indicated in the 3rd Circular, you may need to contact the organisers any time:

Daytime,

Hungarian National Museum Dept. of Public relations: (00-36-1) 327 7768 or (00-36-1) 327 7773

All times, from 23-28 October:
Krisztina Fonti (00-36)-30-9 764 286, from Hungarian machines: 06--30-9-764 286 or Judit Lovas (00-36)-20/456 27 14, from Hungarian machines: 06-20/456 27 14

ABSTRACTS

L-01

CERAMIC TECHNOLOGICAL TRADITION: WHAT FOR?

Attila Kreiter[1] -- Bernadett Bajnóczi[2] -- Péter Sipos[2] -- György Szakmány[3] -- Mária Tóth[2]

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This study examines the relationship between technology and social organisation. By the means of macroscopic, microscopic, ceramic petrological, X-ray diffraction, X-ray fluorescence and cathodoluminescence analyses this study investigates the relationship between ceramic technological practices and the possible ways that technological choices and the use of raw materials may be used to asses social relationships between people. Through the concept of technological style, this study aims to break boundaries between the functional and social nature of technology and argues that the two are inseparable and that together they form a culturally accepted product.

The concept of technological style incorporates material selection, preparation and manufacturing and highlights the relationship between technology, manufacturing sequences and social production. The raw materials and techniques used during potting are considered to acquire a wide range of meaning during their manufacture and use. Ceramic technology is viewed as a process in which different social practices produce different kinds of social relations. It is through this process of interaction that technologies may be considered to create different categories of social relations. The technological choices and the possible meaning of these choices are investigated through Early and Middle Bronze Age ceramic technologies at a tell settlement of Százhalombatta, Hungary.

L-02

COARSE CERAMICS WITH CALCITE INCLUSIONS: A TECHNOLOGY FOR ALL AGES

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The use of carbonate inclusions, more precisely suitable ground spathic calcite, in the production of coarse ceramics is documented since prehistoric times. It is one of the few technologies, which did not feel the effects of the passage from prehistoric native cultures to Roman culture. On the contrary, this last had an enormous influence on other processing techniques, both in ceramic and non ceramic sectors.

The continuity of introducing small calcite fragments in ceramic bodies is here demonstrated from prehistoric ceramics coming from Italian Neolithic settlements, as well as for contemporary production of ceramic baking-pans, the latter being produced today in small quantity for cooking the well known Italian 'piadina'. Various raw materials (siliceous sand, grog, pumice-stone, volcanic sand, etc.) have been used in the past for the production of coarse ceramics, but their use seems to have been often connected with specific chronological periods and with the local availability of these materials.

The introduction of ground calcite represents a correction of the clay body in order to favour the formation of a microstructure less sensible to the thermal dilatation, so improving the thermal shock resistance of the ceramic material. In fact, since prehistory artefacts made of coarse ceramics were usually utilized for cooking foodstuffs.

In this paper the results of archaeometric investigations are presented, which have been carried out on several samples of 'calcitic' coarse ceramics coming from archaeological contexts of different ages in Italy. In particular, the characterization of the samples has been carried out mainly through observations of thin sections with an optical microscope, x-ray diffraction and thermal analyses. In addition, the significance of our experiences is strengthened by taking into account several published studies concerning 'calcitic ware' coming from both Italian and not Italian archaeological sites.

L-03

(RE)DISCOVERING CERAMIC STRUCTURE: A MULTI-SCALAR APPROACH TO UNDERSTANDING ANCIENT CERAMIC PRACTICES

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Over the last decade, many archaeologists and archaeometrists have moved away from studies of ceramic vessel form and decoration to post-structuralist inspired investigations of vessel technologies, and "ceramic practices" more generally. Technique development towards this end has focused mainly on the production of compositionally-oriented datasets that make use of techniques developed in the physical sciences, such as instrumental neutron activation (INA), particle induced x-ray emission (PIXE), inductively coupled plasma mass spectrometry (ICPMS), and x-ray fluorescence (XRF). These new instrumental approaches have all been dramatically incorporated into the repertoire of contemporary archaeological practice, often at the expense of older techniques such as scanning electron microscopy and petrography. In this paper we argue that while compositional data is certainly important to the delineation of ancient ceramic difference, potting community traditions, and clay resource domains, investigations of ceramic *structure* are also essential to developing systematic understandings of past ceramic assemblages that are committed to any practice-oriented analysis.

As a multi-scalar concept, structure ranges from the most macro-scale of perceptions, such as form and exterior vessel features, to meso-scale attributes such as paste characteristics and formational strategies, to micro-scale aspects such as elemental composition and sintering features. As such, structure must be examined from a) a multi-scalar perspective using b) multiple instrumental (multimodal) platforms over c) datasets derived from sets of artifacts at the assemblage level found in secure contexts. We are currently engaged in such an assemblage-based, multi-instrumental, multi-scalar investigation of ceramic assemblages from the southern Caucasus, the southern Urals, and north-central China. By applying scanning electron microscopy, x-ray diffraction, and radiographic techniques to this dataset we are developing protocols for a multi-scalar ceramic archaeometry that seeks intricate understandings of vessel structure based on assemblages of ancient sherds.

We focus here on radiographic techniques, in particular digital radiography and computed tomography, which are in and of themselves multi-scalar, and allow for the evaluation of ceramic vessels from the macro-scale of entire pots down to the 25 micrometer view. These techniques are also multimodal, producing 2-dimensional radiographs, and 3-dimensional, "sliceable" images. We outline how this sub-set of techniques can be marshaled to produce a multi-scalar analysis of structure based on our varied assemblages.

L-04

GREAT POTS ON FIRE: THERMAL PROPERTIES OF ARCHAEOLOGICAL CERAMICS

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Among the most significant advantages of ceramic materials are their enhanced thermal properties. Ceramics are heat resistant, i.e. they remain inert at considerably high temperatures and they present relatively high thermal shock resistance and heat capacity. For this reason they were the most common materials for various applications involving the use of heat, from daily life, such as cooking, up to specialised technical processes, metallurgy or glass making. Depending on the application, however, different properties were required regarding the heat capacity and particularly the thermal conductivity. In some casesceramics with high thermal conductivity were required, such as cooking pots, and in other cases such as smelting processes, ceramic furnaces with insulating properties were required. Mechanical properties in terms of strength and toughness had to be suitable for the particular function.

The physicochemical properties of the ceramics depend on the nature of the raw materials, on the clay paste processing and on the firing technology. Indeed, various approaches can be observed in ancient functional ceramics, towards achieving suitable material properties. Most of these strategies concerned the ceramics' microstructure, i.e. porosity and type, size and distribution of inclusions. In this paper ceramic microstructures are assessed for their thermal properties by computer simulation. In order to achieve this, each ceramic sample was regarded as a multiphase composite, with the clay body, the voids and the particular inclusions being the different phases. Based on observations multiphase models of ceramic structures were developed and tested with computer simulations for the resulting thermal properties. In order to verify this simulation approach, the thermal properties of test ceramics with controlled microstructures were measured in laboratory experiments.

By knowing the properties of the base material components, computer models of particular ceramics can be developed. These models can be tested for their simulated performance during use in terms of heat transfer and thermal stress. The results demonstrate the importance of all the parameters that constitute ceramic technology in the thermal performance of the final products.

L-05

DESIGN, DEVELOPMENT AND TESTING OF A TRANSPORTABLE BACKSCATTERING MÖSSBAUER SPECTROMETER FOR CERAMIC SURFACE ANALYSES

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Ceramic materials have widely been studied by Mössbauer spectroscopy in order to obtain chemical and physical information, mainly regarding its oxidation state. The main limit of this technique is that a powder sample, for which a spectrum can be obtained in a transmission geometry, is always required defining Mössbauer spectroscopy as a destructive and invasive technique and usable only in a specialised laboratory. The only way to get a spectrum without sampling is to change geometry and to measure the radiation reflected by the sample. In this way a surface analysis is possible, obtaining chemical and information only of the outer layers of the artefacts, i.e., oxidation number, identification of the Fe baring minerals. To do so, a reflection geometry may be used, but also in this case a small and thin object must be used, making this technique non destructive but still invasive. To overpass this problem a transportable Mössbauer instrument able to work in backscattering geometry has been projected and realized at the Mössbauer laboratory of the University of Padova.

It is based on the scheme of traditional transmission spectrometer with the main difference due to the fact that the γ-rays scattered by the iron atoms are collected by an array of four proportional counters placed around the sample on the same side of the radioactive source. As a consequence, four spectra are simultaneously recorded that are finally added to increase the signal to noise ratio. An appropriate software enable the spectrum analysis before the fitting procedure, allowing a better control of the resolution by choosing the best spectra addition. In this way spectra are easily obtained in a reasonable time without even touching the material. To control the quality and the reliability of the instrument spectra of metallic iron, pure hematite and other Fe(III) bearing minerals have been collected. To test the apparatus on ceramics artefacts several experiments on original specimens were performed inside the laboratory.

L-06

NEOLITHIC MINIATURE CERAMIC VESSELS – PRODUCTION OF CHILDREN?

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Miniature ceramic shapes and especially poorly made miniature vessels are known from many archeological cultures and periods. Obviously, the interpretation of these practically useless pots remains unresolved. It is proposed that these vessels were used for ritual purposes, as offering at loam pits, potter's trial clay samples, prehistoric "pyrometers", or also as practice pieces by children learning to become potters or made by children as toys. We studied 7 Neolithic miniatures from Těšetice-Kyjovice Site (approx. 5kyr B.P.), assigned to the so called Moravian Painted Ware Culture (MPP), part of the Lengyel Culture Sphere. On various spots of the surfaces of these miniatures we observed depressions due to impressed finger tips. Additionally, sickle-like nicks corresponding to fingernail impressions, mostly located inside the vessels' concavity, were encountered. Besides the nailprints, the concavities were accompanied by imprints of epidermal ridges. We compared the imprints with imprints from other Neolithic ceramics and also with our reference sample. As a result of mutually independent evidences (breadth of epidermal ridges, size of finger tip concavities, size of nail imprints) it may be stated that children were directly involved in the process of the creation of these miniature vessels, whatever their function may have been.

L-07

3D-ACQUISITION OF ATTIC RED-FIGURED VESSELS AND MULTI-SPECTRAL READINGS OF WHITE-GROUND LEKYTHOI OF THE *KUNSTHISTORISCHES MUSEUM* VIENNA FOR THE NEW CVA VOLUME

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Motivated by archaeological requirements we are developing a system based on 3D-acquisition based on structured light for archaeological documentation and a system for art-historic analysis of medieval paintings using multi-spectral readings of color pigments. Therefore the archaeological documentation including automated profile estimation has been tested on different excavations within different projects in Austria, Turkey, Israel and Peru. The methods for art-historic analysis have been tested on paintings from the *Belvedere* collection in Vienna, Austria (Project *Cassandra*).

We combined these two systems for documeting 107 red-figured vases and 20 white-grounded Lekythoi of the partially unpublished collection of antiquities of the *Kunshistorisches Museum* in Vienna. These vessels have been acquired with a 3D-scanner using a laser-plane (structured light) and a digital camera resulting in a 3D-model containing texture map (color information of the surface). As the texture map does only describe the colors seen by the human eye, we chose to add multi-spectral readings of 17 vessels, which were enriched by post-burning applied painting to determine the reflection properties of the pigments in the full spectrum of light (Near-Infrared to Ultraviolet), which will lead to the classification of the ingredients used for the paintings. Finally the setup for the multi-spectral readings was acquired with the 3D-scanner and registered to the 3D-model of the vessels. This allows a precise (<0.1 mm) location of readings of points of interest (e.g. red paint for coats and hair, black, pink, blue and green for clothing and diverse objects) for proper documentation. The 3D-model enables us to compensate deviations of the spectral data introduced by the curvature of the surface.

The presented work was conducted within a publication-project of a new volume of *Corpus Vasorum Antiquorum* (CVA). Therefore we show results for traditional publication based on 3D-models by automatically estimated profile lines, horizontal and arbitrary cross-sections for handles and views from the top of the vessels e.g. having a trefoiled-mouth. Additionally we show the unwrapped paintings with the registered multi-spectral readings, which will give evidence for further analysis about the authenticity and origin of the vessels. Furthermore we show that the proposed - combined - system is non-invasive, because it is contact-free, radiation-free and can be applied in an efficient way by acquisition of up to eight vessels a day within the museums storage, which means without moving the objects to another place. All work has been done with respect to the *London-Charter* to ensure the intellectual integrity, reliability, transparency, documentation, standards, sustainability and accessibility of the information gathered by 3D-acquisition.

L-08

VITRIFICATION AND OPTICAL ISOTROPY/ANISOTROPY OF MATRIX IN RELATION TO FIRING TEMPERATURE ON THE EXAMPLE OF THE SO CALLED "POLISHED YELLOW CERAMICS" OF THE CAROLINGIAN PERIOD (9TH C. AD)

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In the first phase of a series of investigations SEM pictures were taken of broken surfaces of archaeological samples of the so called "polished yellow ceramics" of the Carolingian Period (9th c. AD) in order to describe the grade of their vitrification. It has been shown that there are differences in the grade of vitrification within the main petrographic groups. This was interpreted as a difference in the firing temperature. This interpretation was supported by the results of XRD measurements and polarizing microscopy (isotropy/anisotropy of matrix).

In order to be able to connect certain vitrification patterns and matrix isotropy/anisotropy with certain firing temperatures, in the second phase of the investigations pieces of weakly vitrified archaeological samples from each petrographic group were refired at 800, 900 and 1000°C in an electric oven. Broken surfaces of the refired samples were then studied in SEM and thin sections of them were analyzed by polarizing microscopy.

It can be shown that the refired samples (originally low fired archaeological samples) developed similar vitrification patterns (SEM) and matrix isotropy/anisotropy at higher temperatures similar to the archaeological samples that were originally fired at higher temperatures. In this way the firing temperature of all original archaeological samples can be estimated with greater precision.

As a second result of these investigations it was also possible to establish a reference collection of SEM vitrification images and matrix isotropy/anisotropy patterns from the polarising microscope calibrated to known firing temperatures. Parts of this reference collection are going to be presented and their similarities and differences to the SEM investigations of M. Tite and Y. Maniatis are going to be discussed.

L-09

GROG OR CLAY LUMPS, ADDED TEMPER OR NATURAL INCLUSIONS?

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The technique to add grog as a temper to the body of pottery vessels is in use from the 6th millennium in N-Syria up to nowadays. In thin sections, however, in many instances it is hard to distinguish the various kinds of argillaceous inclusions from each other. Neolithic pottery which we studied from sites in Syria, Greece, Germany and Poland may contain all kinds of argillaceous inclusions as grog, rock fragments from mudstone or shale, or rounded or angular clay pellets as natural inclusions. The secure identification, however, is important for the interpretation of the manufacturing technique and is used by archaeologists to distinguish classes of pottery in spite of the fact that the macroscopic determination of added grog is nearly impossible. Samples derived from potters still using this technique and from some systematic experiments will be shown to demonstrate the difficulties. Besides typical features in thin-sections, described e.g. by Ian Whitbread in Archaeometry 28, 1986, we also used the firing behaviour both of the body and of the inclusions appearing in refiring series (MGR-analysis). This allows us to distinguish previously fired inclusions (grog) and clay lumps which were fired together with the body. Inclusions of the same clay or inclusions of a different clay can be recognized. Photomicrographs of sherds and of the experimental samples as well as refired samples will be shown to demonstrate some typical features helping in distinguishing the various kinds of inclusions of argillaceous material.

L-10

SERRA D'ALTO NEOLITHIC WARE IN THE FOURTH MILLENNIUM BC OF SOUTHERN ITALY

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"Serra d'Alto" Middle-Late Neolithic ware is widely diffused in Southern Italy during the IVth millennium BC and it shows homogeneous formal and technical features. It mainly consists of fine depurated pottery, dark brown painting with complex geometrical motives, with ribbon handles often surmounted by plastic appendices. Its wide distribution, with the recurring vessel forms and decorations, and its frequent occurrence in funerary/cultic? contexts, has led many scholars to emphasise its exchange value: this ware would represent a prestige wealth in a large net of middle distance exchanges.

The aim of this archaeometric project is to verify the hypothesis of circulation of finished ceramic pots rather than of production models in different areas in Southern Italy. The first efforts focused on building up a wide database concerning mineralogy, petrography and chemistry of more than one hundred pottery samples from many excavated Neolithic villages settled in Apulia (Tavoliere and Murge), where this ware is largely documented. In this paper a new large set of 131 pottery samples will be presented from 9 excavated Neolithic villages settled in Basilicata (Bradanic trough), Calabria (Plain of Sybaris) and Sicily, where this ware is probably produced and/or exchanged.

Thin section analyses show a clay matrix quite rich in non-plastic inclusions among which sheet-silicate mica crystals are recognisable. Some petrographical groups with different grain-size distribution (mainly ≤150/200 μm) and composition can be distinguished. Textural features and low birefringence relates to a high synterization grade. Mineralogical analyses (PXRD) show in almost all samples the occurrence of new phases, such as diopsidic pyroxenes, gehlenite and hematite. The mineral assemblage points to a firing temperature range between 850 and 1,050 °C. Chemical analyses evidenced that SiO_2, Al_2O_3 and CaO were the main oxides, with some variations as regards CaO, Na_2O, K_2O and MgO percentage. Also trace element concentrations confirm the homogeneity between samples, although some elements are significant to distinguish different sub-groups of pottery related to their geographical setting.

The mineralogical components of the ceramics fit very well with those of different marine clays which crop out in different areas of Southern Italy. The Plio-Pleistocene marly clays of the Bradanic trough were used in Basilicata, while Calabrian grey marly or silty clays of the Crati River were used in the Plain of Sybaris. The hypothesis of a wide diffusion of technological models of production can be confirmed. In Middle and Late Neolithic societies the pottery production, mainly of fine brown painted or plain ware, probably evolved from a "domestic mode of production" to an "incipient-specialization stage". This stage would include an increasing standardization of paste composition, reflecting greater exploitation of particular kinds of local clay, the improvement in forming, finishing techniques and in an advanced (up to 1,000°C) firing technology.

L-11

THE NEW SEARCHES FOR KURA-ARAXES CULTURAL COMPLEX : THE PETROGRAPHIC AND GEOCHEMICAL ANALYSIS OF SOS HÖYÜK KURA-ARAXES CERAMICS

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The Early Bronze Age culture of northern mountainous zone, namely Kura-Araxes Culture, Karaz Culture or Early Trans-Caucasian Culture had existed in a huge area, which extends from the Caucasus range to Philistine. This cultural complex can be discerned with its own peculiar architecture (rectangular and round shaped houses, socio-economic livelihood methods, limited agricultural activities and expansive animal husbandry-pastoral groups) and cultural materials (pottery, distinct clay objects and limited metal objects). The culture lasted for almost two thousand years from mid. 4th to mid. 2nd millennium BC, and this long-term endurance created several chronologically and geographically complicated problems in the understanding of the structure of the mentioned culture. The problems appear also in its denomination and chronology. Because of its existence through a long time and its huge geographical distribution, the culture is seen as "a cultural complex" by most archaeologists.

According to most scholars, these very complicated problems can be solved by increasing local investigations. The most numerous remains of this culture are pottery. The most distinctive features of the pottery of Kura-Araxes Cultural Complex are summarised as follows: they are mostly hand made and the dominant colours are black, red, brown and grey tons. The pots are generally decorated with incised, grooved, dropped and relief techniques. The form repertoire consists of varieties of jars and bowls. Pottery is also a significant source in solving complicated problems. The studies involving pottery show diversity from traditional methods to several analytical techniques. Particularly analytical work (petrographic analysis) on the pottery has been carried out recently. This kind of analytical study can give information on a wide field, ranging from manufacturing stages to expansion of culture.

In this study we want to focus on Erzurum Region, which is situated roughly in the north corner of the Anatolia Peninsula. As known, the Erzurum Region, especially with Karaz, Pulur, Güzelova and Sos mounds, has a special place within the spectrum of this culture. Especially Sos Excavation is a key site in form of main features of archaeology in this region. Sos Höyük was excavated by A. Sagona from 1994 to 2003. The site presents a continuity in settling from Late Chalcolithic period to Mediaeval Ages. In this work we report the results of a petrographic, major and trace element analyses of Kura-Araxes

wares from Sos Höyük. The aims of the study are to establish the provenance of selected samples and to determine the production pattern of Kura-Araxes ceramics during the Late Chalcholithic to the Middle Bronze Age (ca. 3500-1500 BC) in Sos Höyük. The results will also be discussed with regard to the socio-economic organization in this region and compared to the results carried out in previous works in other regions (Amuq Valley, Malatya region, Godin Tepe in central western Iran). Archaeometrical results suggest that the analyzed samples were locally produced, most probably for household use. In relation to the ceramic tradition and socio-economic organization, our data are comparable to those of previous works from Amuq valley, Malatya region and Godin Tepe. Contrary to these regions, in Sos Höyük there has been no technological innovation or changes in the ceramic production from the Late Chalcolithic to the Middle Bronze Age, which indicate the arrival of new population to the region.

L-12

BELL BEAKER PRODUCTION AND CONSUMPTION ALONGSIDE GUADIANA RIVER: AN IBERIAN PERSPECTIVE

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Alongside the Guadiana River (Iberian Peninsula) several settlement networks are located for the Iberian Cooper Age period -*ie.* Perdigões, Reguengos de Monsaraz, Portugal (Valera 2006; Dias et al., 2005), or Tierra de Barros, Badajoz, Spain (Hurtado, 1995, 1999), where it has been found a clear relation between the forming sites in terms of pottery production and consumption. Since the 70's the Beaker Network paradigm (Clarke, 1976) has been systematically brought to question in explaining the broad and fast expansion of these pottery styles all over Europe and North of Africa, and till nowadays there is no broad research projects similar to ours that studies pottery distribution patterns on the basis of physico-chemical analysis.

The framework for this work is a larger research project (GRICES-CSIC a collaborative research framework between Spain (CSIC) and Portugal (GRICES)) focuses on technological production and consumption alongside the Guadiana River and that is actually under development.

In this work we study by physico-chemical methods (INAA, XRF, XRD and TL) the production technology and the consumption of 200 sherds of Bell Beakers and decorated vessels from 4 of the largest settlements throughout all Iberia that are found alongside the Guadiana River forming part of different networks (La Pijotilla, San Blas, Porto Torrao, Perdigões) as well as medium size sites (Monte do Tosco, Molino Perdido), in order to stablish cosumption and distribution patterns within the pottery production of these sites.

Our goal is to characterize and categorize ceramic productions at these sites, on the basis of physico-chemical analysis, in order to assess possible patterns in the production and distribution of these "prestige" wares, and provide the basis for a more integrated picture of social boundaries and exchange networks alongside the Guadiana River. Principal component analysis (PCA) was used to reduce the number of variables and model-based cluster analysis was also used to find clusters in the compositional data.

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L-13

CONSTRUCTING A CERAMIC WORLD: EVIDENCE FOR PRODUCTION, EXCHANGE AND CONSUMPTION IN AN EARLY MINOAN VILLAGE

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The site of Myrtos Fournou Korifi (MFK) lies on the south coast of Crete, atop a low-lying hill overlooking the Libyan Sea. Destroyed suddenly during Early Minoan IIB (the mid-third Millennium BC), it provides unrivalled insight into the Early Bronze Age of Crete, having hundreds of vessels found in the destruction horizon associated with architecture which has been interpreted variously as comprising some sort of communal building or – perhaps more realistically – an agglomeration of household units.

The pottery assemblage has been studied according to a methodology that integrates physico-chemical analyses with detailed morphological and stylistic data, along with macroscopic accounts of fabric and evidence of forming. A number of questions regarding provenance and technology have been answered, producing a detailed breakdown of the ceramics present in the settlement upon its destruction. The analytical approach combines thin section petrography, neutron activation analysis and scanning electron microscopy to gain information from raw material sources, through function-specific raw material recipes, to microscopic evidence for slip and paint composition and firing practice. A total of 225 samples were examined for these purposes.

From this we are able to re-assess the postulated workshop on the site, identify three main source areas for the pottery and identify the proportions of pottery from each. Detailed technological reconstruction has allowed the comparison of different products from the same centre of production, and of similar pottery products from different production locations. While the former enables us to examine function-specific clay recipes and possible site specialization in production, the latter allows us to enter the realm of competence, skill and reputation of ceramic products and potters, perhaps even to address questions of itinerant craftspeople.

Finally, the distribution of these vessels across the site allows us to make comments about differential consumption of ceramic products, as well as re-assessing aspects of function. On a broader scale, comparison of the pottery at MFK with that of surrounding sites gives insight into regional consumption patterns.

We will demonstrate that MFK comprises a classic example of an integrated provenance and technology project, whose conclusions have a far-reaching for our understanding of Early Minoan society, as well as showing the rich potential of such an embedded analytical project.

L-14

FIRING TRANSFORMATIONS IN LATE BRONZE AGE CERAMICS FROM TRANSYLVANIA (ROMANIA)

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The studies of thermal transformations of clays and temper during firing support the understanding of the high-*T,* low-*P* transformations of silicate phases, both in artificial (*e.g.*, ceramics) and consequently natural (*e.g.*, pyrometamorphic) systems. At the same time, these studies can unveil the technological achievements and knowledge of raw material sources of ancient civilizations. And last but not least, the results may be used for the selection of paste composition necessary for restoration of ceramic artefacts during cultural heritage interventions.

Coarse and semifine ceramic potshards of Late Bronze Age (1400-1200 B.C.) found in North Transylvania (Romania) were studied by Optical Microscopy in plan-polarized light (OM), X-Ray Powder Diffraction (XRD), Scanning Electron Microscopy (SEM), Electron Microprobe (EMP), Attenuated Total Reflection Fourier Transform Infrared (ATR-FTIR) and Electron Paramagnetic Resonance (EPR) analyses in order to identify the phases and their thermal transformation during the firing. The ceramics consists basically of a clayish matrix with combined crystalline and amorphous fabric and exhibits different degrees of sintering and vitrification. In the matrix, variable amounts of magmatic, metamorphic and sedimentary lithoclasts, as well as various crystalloclasts, ceramoclasts and rare bioclasts are present.

The study reveals small-scale thermal processes i.e. melting, diffusion, recrystallization, which affected the matrix and its relationship with the clasts. The most important is the change of the clayish matrix, where the particles are sticked together by sintering and/or melting processes. Fe migrated from the matrix into the softened rims of quartz grains. Parts of feldspar clasts became isotropic due to the collapse of their crystalline structure. The amorphous melt intruded into the cracks. New phases such as glass, gehlenite, wollastonite, hematite, anorthite, leucite, K-feldspar, and mullite formed as well.

The firing conditions for the Late Bronze Age ceramics could be approximated between 800 and 1000^{o}C. The mineralogical composition of the matrix as inferred from the EMP data indicates that ceramics were made by mixing of kaolinitic-illitic and illitic-kaolinitic (±smectite) raw clays, with some Fe-oxihydroxide content. The clays could have derived from Badenian kaolinitic-illitic and illitic-kaolinitic clay sources that were located at hand. The petrographic and mineralogical composition of the clasts points to the alluvial sandy sediments as tempering materials, derived from the Somes river flowing nearby the site.

L-15

BICHROME WHEELMADE WARE: ORIGIN AND REPRODUCTION

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Bichrome Wheelmade Ware is one of the most important mirrors for ancient Mediterranean trade routes and networks at the beginning of the Late Cypriot Bronze Age (LC I). The ware was widely distributed in the entire Eastern Levant, from Turkey (Alalakh) over the Syrian, Lebanese and Canaanite coast down to Egypt. In Cyprus, Bichrome Wheelmade Ware has been found at nearly 40 sites. The wide distribution makes this requested ware an important tool for synchronizing the chronology of Cyprus with that of the eastern Mediterranean civilizations.

The origin of the Ware is of immense interest. Various vessel types and a large variety of decorative motifs inevitably requires that the LC Bichrome issue needs to be considered as an issue of originals and imitations in different places in the Levant region.

Comprehensive petrographic (optical microscopy), mineralogic (electron beam microprobe, XRD) and geochemical studies (ICP-MS, XRF) on Bichrome material from Tell el-Dab'a in the Eastern Nile Delta indicate clearly that the examined wares were partly imported from Cyprus and partly reproduced locally. The results make it possible to characterize and distinguish two chemically and mineralogically entirely separate groups, which correlate well with reference samples from both localities. The Bichrome Wheelmade Ware samples from Cyprus are at a higher technological level and have a chemical signature referring to the ultramafic and mafic rocks of Cyprus. The manufacturing of the Egyptian Ware is not so well developed and the local reproductions are demonstrably made of Egyptian Nile-silt.

L-16

CLAYEY RAW MATERIALS DATABASE AS A TOOL FOR INDIVIDUATION AND KNOWLEDGE OF ANCIENT CERAMIC PRODUCTIONS IN SOUTHERN ITALY AND SICILY

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Provenance of archaeological ceramics is a "key question" that often requires a petro-chemical approach. Southern Italy and Sicily (*Magna Graecia*) have represented a cultural and socio-economic point of reference for the whole of the western Mediterranean since prehistoric times. Their complex history, which has seen different cultures and civilizations through times, is also reflected in pottery production. The first Italian pottery production groups here are documented from the end of the VIIth millennium B.C. This area represented both a collecting and a reworking point of the Aegean models from the XIIIth century B.C. In each territorial context it is crucial from the archaeological point of view, the discrimination of local productions from imports as well as their diffusion range. The Serra d'Alto ware production in the Middle Neolithic and the black-gloss pottery constitute two well established case-studies confirming the above statement.

Today, the geological literature concerning the compositional characterization of potential clayey raw materials is poor in the studied area. Most of previous existing data were not collected by a proper archaeometric approach, and they are also inhomogeneous in terms of analytical procedure.

Following these considerations, research groups involving the Universities of Bari, Calabria, Catania, Messina and Palermo focused their efforts on a programme aimed to build up a wide database concerning mineralogy, petrography and chemistry of clayey deposits that have been used as raw materials for ceramic production from prehistoric to medieval ages.

Selection criteria were based on geological knowledge of each territorial context, considering both the specific clay used by past time manufactures and the closeness to archaeological production sites as well. More than one thousand samples were collected and considered to be representative of ceramic raw materials traditionally used in Apulia, Calabria and Sicily. The number of samples has also been planned in order to evaluate the compositional variability within the studied clay formations cropping out in a wide area. The samples were analysed by XRD, XRF and polarized light microscopy (sandy fraction). Moreover, a consistent number of materials has been subjected to experimental firings in order to appreciate some "technological" parameters associated with the firing process (colour, linear shrinkage, plasticity index). The final goal is to offer a proper archaeometric reference data set to the scientific community in order to investigate the circulation of ceramic classes and/or production models in Southern Italy, not depending on chronological or typological restrictions.

L-17

POTTERY SUPPLY OVER THREE MILLENNIA: PETROLOGICAL AND GEOCHEMICAL CERAMIC CHARACTERISATION AT MELTON, EAST YORKSHIRE, UK

Alan Vince

Archaeological excavations in advance of road widening at Melton, East Yorkshire, revealed a sequence of rural land use starting with funerary monuments in the Early Bronze Age (c. 2300-1200 BC) and continuing, with breaks, into the late medieval period (14th century AD). A large programme of petrological and geochemical analysis was carried out on the pottery and fired clay artefacts from this site and the results reveal the changing sources of clay and sand utilised by potters in the area over a period of at least 3000 years. The unusual location of the site and the existence of a large database of petrological and geochemical data for the surrounding region enables ceramics to be characterised with a precision which is unusual in an area of sedimentary geology as well as allowing ceramics produced outside of the locality to be identified with some certainty. The results reveal the economic links of the occupants of this area; the radical effect of the Roman empire and its collapse and the emergence of a market-based economy in the medieval period.

L-18

TECHNOLOGIES IN TRANSITION: ANALYTICAL RESEARCH ON FINAL NEOLITHIC/EARLY BRONZE AGE POTTERY FROM KEPHALA PETRAS, EAST CRETE, GREECE

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The investigation of provenance and technology of ancient ceramics using of a broad array of analytical techniques has been a common theme in archaeological studies during the last two decades. This integrated approach opens new possibilities in the exploration of issues such as pottery traditions, technological choices, and human agency. These issues are of particular importance when dealing with transitional phases in which technological changes are also discernible, as in the case of the transition from the Neolithic to the Bronze Age. The aim of this presentation is to discuss the results of a study combining thin section petrography and scanning electron microscopy for the understanding of a ceramic assemblage from the settlement at Kephala Petras in Sitia, East Crete, dated to the Neolithic - Bronze Age transition (c. 3000 BC).

The available architectural and ceramic evidence shows two main phases of occupation dated to the Final Neolithic (FN) and the Early Bronze Age 1 (EBA1) periods, respectively. The pottery of the earlier phase (FN) has close affinities with sites outside Crete, namely the Dodecanese. However, it is questionable whether such typological similarities correspond with population movements, as traditional views imply. The application of thin section petrography provided valuable insights in this respect by identifying the local and imported components of the assemblage.

With regard to technological issues, the macroscopic study of the Kephala pottery indicated possible changes in the ceramic technology from the earlier (FN) to the later (EBA1) period, seen especially in the firing techniques. These changes become of essence considering that the same site produced the earliest evidence for metallurgy in Crete, namely copper smelting. Within this context, the integrated approach combining thin section petrography and scanning electron microscopy contributed significantly in identifying the technological characteristics of each period, defining the advances from the one period to the other, and investigating the possible influence of the new pyrotechnology (metallurgy).

L-19

TECHNOLOGICAL CHOICES AT THE ONSET OF THE IBERIAN BRONZE AGE: AN INTEGRATED APPROACH TO CERAMICS OF THE MONDEGO PLATEAU, PORTUGAL

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This paper focuses on ceramic technology in the Mondego Plateau (Central Portugal) during the mid-third to early second millennium BC, a period that witnessed distinct changes in ceramic morphology and decoration. Technology is here viewed as the whole process of manufacture, from the mixing of raw materials to produce the paste, through to the forming techniques and styles of decoration, and finally the firing of the vessels.

The study takes in three sites that stand out for their well-contextualised ceramic assemblages: Carapito III (a burial site), Malhada (a settlement) and Fraga da Pena (a 'gathering place'). These sites are representative of the archaeological diversity of this period, documenting different contexts of pottery production, use and/or deposition.

However, the pottery studied presents a range of problems for the analyst, being rather non-standardised, coarse and heterogeneous in paste, with a limited range of shapes. Types are long-lived across the prehistoric period and specific functions can rarely be ascribed. This situation provides a distinct challenge, and contrasts markedly with time periods and regions where the scale, nature and diversity of production might aid differentiation between distinct ceramic categories.

A contextualised characterisation of the pottery of this period was achieved by combining thin-section petrography and chemical composition by neutron activation analysis with detailed information on morphology and decoration.

The methodology used has produced a new picture for this period in the Mondego Plateau, notably through the investigation of clay recipes, and the integration of the general characterisation of technology with a detailed consideration of variability at each site. This approach facilitates an interpretation of technological variability that is rooted in social and technological practices, and that is of importance to our understanding of human groups living in this region during the Chalcolithic to Bronze Age transition.

L-20

'RICH IN SILVER' POTS: SOURCES AND CIRCULATION NETWORKS OF COARSE RED SILVER MICACEOUS FABRICS IN BRONZE AGE SW AEGEAN

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Ceramic vessels of coarse red fabrics, particularly rich in silver mica, found in many sites of central and southern Aegean, throughout the Bronze Age, are traditionally associated with an origin in the Cyclades. Nevertheless, a similar type of a very distinctive fabric (known as Red Silver Micaceous, RSM) becomes very common on the island of Kythera, in SW Aegean, during the Second and Third Palace Periods, as proven by excavations at the coastal site of Kastri and the Kythera Island Project intensive field survey. Additionally, the RSM fabric is also recognised in a wider region, particularly in sites in southern and eastern Peloponnese and western Crete, relating to plain or white-painted vessels, such as storage and cooking pots as well as table ware. These vessels had been variably associated with a Cycladic, Laconian or Kytheran origin.

The defining characteristics of the RSM fabric, are its hard, red, dense clay matrix and inclusions of micaceous metamorphic rocks with quartz, muscovite, orthoclase and plagioclase occurring as major minerals.

Ceramic petrology coupled with geological prospection has located the source of this pottery to the region directly surrounding the modern village of Potamos, north-central Kythera. Here, lenses of orthoclase-bearing orthogneiss are intercalated with the glaucophane-chloritoid-phengite schists of the Phyllite-Quartzite Unit (PQU). These represent ancient (c. 300 Ma) basement metamorphosed at amphibolite facies, and subsequently suffering a mild overprint during the (lower grade) high pressure, low temperature metamorphism affecting the PQU at c. 55 Ma. The lithic fragments observed in the RSM sherds bear a strong textural and mineralogical affinity to these orthogneisses and are consistent with being collected from a sedimentary deposit primarily sourcing these rocks with an additional minor input from the PQU.

The juxtaposition of these lithologies is unique in this region and therefore has lead to a precise identification of Kythera as its production centre. Furthermore, comparisons with similar rocks in the Aegean region indicate the textural and mineralogical distinctiveness of the Potamos Orthogneiss in relation to the assemblages of granitoids in the Cyclades and East Crete, and provide firm distinguishing criteria for ceramic fabrics originating in the 'hot' metamorphics of the Cycladic islands and the 'cold' metamorphics of the PQU in the Greek mainland and Crete. In the light of this new evidence, the distribution of the RMS ceramic vessels both within the island of Kythera and beyond it, and their affiliation with 'Minoan' potting traditions, provides a better understanding of the interaction and trade networks in SW Aegean during the Second and Third Palace Periods.

L-21

NEW PETROGRAPHIC DATA ON THE LATE PHASE OF THE LAECANIUS WORKSHOP

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Dressel 6B amphorae, manufactured in the Laecanius workshop between 10-5 B.C. and 78 A.D. in Fažana (Istria, Croatia), producing about 10,000 to 12,000 amphorae annually, were analysed integrating archaeological and geological laboratory methods. Results were published recently by Mange and Bezeczky (2006, 2007).

There are three known phases of the figlina at Fažana, and its whole history can be read from the amphora stamps, from the stone inscriptions and from ancient written sources (Bezeczky, 1998; Tassaux, 2001): (1) From the end of the first century B.C. to A.D. 78 it belonged to the Laecanius family; (2) During the reign of Emperor Vespasian (A.D. 69-79) the last Laecanius died without an heir and the ownership was taken over by the Emperor Vespasian and there is record of its use during Hadrian; (3) Around the last third of the second century A.D. it is presumed that M. Aurelius Iustus rented the workshop.

Petrological analyses characterised the fabric, defined fabric categories, and identified the source of the raw material used in the manufacturing of the Laecanius amphorae during the first phase of the workshop (Mange and Bezeczky, 2006). The aim of our present study is to investigate the nature of amphorae produced during the late phases of the workshop. We continue employing the methods used in our previous study that includes macroscopic description, thin section petrography and heavy mineral analyses.

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L-22

BESIDES VESSELS: INVESTIGATING EARLY NEOLITHIC FIRED CLAY ARTEFACTS FROM HUNGARY

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This paper presents the results of an archaeometric study of plaster and clay artefacts of the Early Neolithic Körös Culture (Hungary), dating to the beginning of the VIIth millennium BP. They represent the production of the earliest farmers of the Carpathian Basin. The research project investigated both potsherds and non-vessel fired clay artefacts, such as the so-called net-weights, loom-weights and plaster fragments, belonging to walls and floors of the architectural features. The latter were studied with the aim of better characterizing the local raw material composition and comparing it to that of the pottery production. In addition, samples of Pleistocene and Holocene clayish sediments were collected from the area of the Neolithic settlements with hand coring. It is in fact supposed that the raw material for plastering the structures of the settlements was collected from sources located, for logistical reasons, in the very close proximity to the sites. The analyses of these samples represent the very first archaeometrical study of this culture in Hungary. The methods of investigation comprise a petrographic study of thin sections with a polarizing microscope of all samples, combined when it was deemed necessary with chemical (XRF, NAA) and SEM-EDS analyses.

L-23

PROFESSIONAL TOOLS IN UNPROFESSIONAL HANDS: ASSAYING CRUCIBLES IN EARLY COLONIAL AMERICA

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One of the driving forces that led Europeans to the conquest and colonisation of the New World was the hope to find plentiful metal ores and noble metals. Things, however, did not always turn out as satisfactory as expected.

This paper focuses on the crucibles excavated in two early European colonies in America: La Isabela (Dominican Republic) – the first European town, founded by Christopher Columbus in 1494 –, and Jamestown (Virginia, USA) – the first British colony, founded in 1607. The analytical study of the technical ceramics focused on their manufacture, material properties and provenance, which could then be related to the metallurgical activities documented at the sites. The techniques employed were optical microscopy, SEM-EDS, ED-XRF and XRD.

In La Isabela, a recent study has shown that the colonists, in an act of desperation, used a very inefficient technology trying to extract silver from very poor ores that they had brought from Spain (Thibodeau et al. 2007). Conversely, the crucibles at the site exhibit an exceptional quality: they are made of a refractory clay containing abundant graphite inclusions, which conferred the vessels with superb material properties for the thermal, mechanical and chemical strains involved in assaying reactions. Compositional and petrographic data suggests that these vessels were made in Bavaria, before being shipped to Spain and, from there, to the American town.

In Jamestown, the crucibles were shown to come from the German region of Hesse. The famous Hessian crucibles were made of a very lean kaolinitic clay, tempered with quartz sand and prefired to very high temperatures. This led to the development of mullite crystals in the ceramic fabric, which rendered the crucibles extremely tough, as well as thermally and chemically refractory (Martinón-Torres et al. 2006). Historical sources mention the involvement of German metallurgists in the British-led colonial enterprise, and the analysis of metallurgical residues suggests that they attempted to test local zinc and gold ores, but obtained very poor results.

Altogether, these case studies provide the earliest evidence for the transport of specialised, high-quality metallurgy instruments across the Atlantic, contrasting with the meager quality and results the metallurgical activities. They add a new piece to our growing understanding of the production and consumption of crucibles in the post-medieval world.

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L-24

THE CHURCH OF NOTRE-DAME-SOUS-TERRE (MONT-SAINT-MICHEL, FRANCE), A CASE OF CERAMIC BUILDING MATERIAL DATING APPLIED TO EARLY MEDIEVAL BUILDING ARCHAEOLOGY

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Notre-Dame-sous-Terre is the oldest remaining church on the island province of Mont-Saint-Michel, France. Used as a substructure for later buildings on the island, the little church, progressively abandoned and forgotten, has been well preserved until the 20th century when it was rediscovered by the archaeologist Paul Gout (1908). Therefore, this small, underground church constitutes the only existing evidence of the monastic origins of Mont-Saint-Michel.

The building is situated at the west of the island and is rectangular in shape. A median wall splits the building into two naves, each with small apses at the eastern end.

The whole building is typologically dated to the last third of the 10th century, displaying masonry made up of granite rubble interrupted by rows of brick, flat brick semicircular arches, rectangular pillars with simple imposts and the absence of an original vault.

This punctual use of ceramic material in the building has been considered for a long time as a practice of re-using Gallo-roman building material in early medieval building.

However, a recent study suggests that the bricks could have been made purposefully at the time of the construction. If this is the case, it would mean that dating this material could lead us to an accurate date of original construction. Moreover, dating bricks from different masonries could allow us to evaluate the phasing of the building.

We are presenting here the results obtained by two different physical ceramic dating methods (thermoluminescence and archaeomagnetism) correlated with historical and archaeological data and their related interpretation.

L-25

EARLY DISCOVERY OF THE GREAT SOUTHERN LAND 250 YEARS BEFORE CAPTAIN COOK'S EPIC VOYAGE

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This presentation follows that given at EMAC05 held in Lyon, France during 2005. This presented evidence of early Portuguese presence around the eastern coastline of Australia during the early 1500's some 250 years prior to Captain James Cook's epic voyage of discovery. Previous evidence had been mainly in the form of early maps such as the Dauphine map of 1536 said to have been drafted in Dieppe. This and other maps are notoriously difficult to interpret and leave much in question. In addition there have been various claims of early discoveries around the coast in the form of buildings, keys, ships and various other artefacts. Again these claims are difficult to substantiate and in many cases have proved false.

The 2005 presentation discussed the thermoluminescence (TL) age determination of various pieces of early pottery discovered around the Australian coastline and claimed to be of Portuguese origin. This presentation refines that data and discusses the results of further dating of newly discovered, similar pottery, mainly trawled up off the south eastern coast of Australia. Much of this pottery appears to have been located in the same area off Gabo Island and is stylistically quite similar. The difficulties in making accurate age determinations upon pottery that has rested upon the seabed at considerable depth are also discussed.

The project discussed therefore attempts to use the presence of pottery found around the south eastern coast of Australia as a finite means of substantiating claims of early visits to the shores of the Great Southern Land.

L-26

THE INFLUENCE OF TEMPER ON PERFORMANCE CHARACTERISTICS OF COOKING WARE CERAMICS

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Mechanical properties of archaeological ceramic vessels have long formed the core of discussion examining issues of functional requirements and the suitability of pottery for its varied uses in the past. Strength, toughness and thermal shock resistance, have all been considered with regard to minimum requirements of vessels, but our current understanding of these properties are still far from complete.

The present study assesses the influence of different parameters which are under the potter's control on the mechanical performance characteristics of cooking ware pottery. Based on the petrographic study of cooking ware pottery from Bronze Age Akrotiri, Thira in the Cycladic Islands of Greece, granitic and phyllitic tempers were chosen for the manufacture of briquettes that were subjected to material tests. Emphasis was placed on the examination of the influence of the *temper shape* (platy vs. angular) on strength, toughness and thermal properties of both calcareous and non calcareous pottery, over a range of firing temperatures. The behaviour of the material is discussed, based on the differences observed in the microstructures of the respective fabrics, which cause different mechanisms of failure.

The results of the study elucidate the significant effect of temper shape on the performance of the ceramics. Furthermore, they will be used to interpret and assess different manufacturing techniques that are observed in the production of cooking vessels during the Aegean Bronze Age.

L-27

POTTERY FUNCIONS AND SUBSISTENCE PATTERN IN PREHISTORY (RUSSIAN FAR EAST AS A CASE OF STUDY)

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Research area is southern part of Russian Far East including mainland territories (Primorye and river Amur basin) and insular territory (Sakhalin island). Pottery-making was an important activity in Far Eastern prehistoric communities. Main factors determining the structure and image of pottery production were: natural conditions, cultural changes and subsistence pattern.

This paper discusses the relationships between subsistence pattern and pottery functions during the Neolithic and Paleometal period in mainland and insular teritories. Pottery function identification is based on the complexity of characteristics: vessel shape and size, qualities of production technology, decoration, use-wear traces and archaeological context.

In mainland regions the Neolithic (8 – mid. of 2 mil. BC) was the time of predomination of hunter-gatherer subsistence (land hunting, river and coastal fishery, land and marine gathering). The mode of life was characterized by strong tendency to sedentary living. Hunter-gatherer pottery does not show evidence of functional differentiation. The vessels are characterized by low degree of shape and size variability. The dominant model was a conical-shaped, unrestricted flat-bottomed vessel.

In Late Neolithic phase (mid. of 3 – mid. of 2 mil. BC) primitive agriculture was invented causing significant changes in pottery production and function patterns. At Late Neolithic settlements the first evidence for changes in pottery making was the appearance of table serving vessels (bowls) and vessels with clear orifice restriction.

Archaeological records of Paleometal period (end of 2 mil. BC – beg. of 1 mil AD) reflect the increasing role of agriculture in subsistence pattern and a development of differences in pottery functions. Storage, cooking, table serving and ritual vessels are indicated based on morphological, technological and decorative features.

In Sakhalin island the subsistence of Neolithic cultures (7 – 1 mil. BC) was based on hunter-gatherer communities corresponding to mobile and semi-sedentary mode of life. Pottery assortment was poor and invariable in technological, morphological and size indexes reflecting an undifferentiated functional pattern.

Paleometal period (1 – beg. of 2 mil. AD) was marked by significant subsistence changes: land hunting and gathering were replaced by sea mammal game corresponding to sedentary living. The main innovation in pottery production was its increasing size range. Use-wear traces show that ceramic containers were used for cooking and storage of sea mammal products while technological, morphological and decorative features do not reflect functional differentiation.

L-28

THE OPTICAL PROPERTIES OF LUSTRES AND THEIR SPATIOTEMPORAL EVOLUTION

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Lustres are one of the most famous decorative objects of the Mediterranean basin during Middle-Age and Renaissance times. They were appreciated for their magnificent optical and colorimetric properties, their colour changing with respect to the orientation in which they were observed. At that time, these effects were considered as magic.

In the last few years a lot of research has been conducted in order to understand the structure and composition of these ceramics. It appeared that at the surface of the lustres, there are nano-particles of silver and/or copper embedded in the glaze. Thanks to these studies, the optical properties of these ceramics could finally be understood and modelled. The first part of the lecture deals with the links between the structure and the optical effects (plasmon absorption, interferences) and present a model used to simulate the optical properties from which it is possible to obtain 3D images of the lustres.

The second part of the lecture concerns the application of the model to understand the optical measurements performed on samples of lustres from different places and different era. A comparison between all these simulations and measurements enhances the differences between the various productions in space and time. From this, a discussion will follow about how the study of the optical effects can lead to a better understanding of the techniques used in the production and the aims followed by the craftsmen.

L-29

COLOUR, MORPHOLOGY AND COMPOSITION OF PARTHIAN AND SASANIAN GLAZED POTTERY

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Samples of Sasanian glazed pottery from Veh Ardašīr in central Iraq (third-sixth century) have been studied by scanning electron microscopy coupled with an energy dispersive X-ray detector (SEM-EDS), together with a few samples of Parthian pottery from nearby Seleucia (first-third century).

Analysis of ceramic bodies reveals a general homogeneity in composition among the studied samples, characterized by high total contents of calcium and magnesium (20-25% CaO+MgO), and sodium contents generally exceeding the potassium ones (mostly 2-4% Na_2O and 1-2% K_2O). Despite a relatively high iron contents (mainly 7-8% Fe_2O_3), all the pastes show a low colour saturation, as expected in the case of calcareous bodies.

SEM images show a high variability of the glaze thickness among the various samples (some 400-1200 μm), and a generally regular glaze to body contact surface; furthermore, they highlight the presence, in most samples, of gas bubbles, relics of undissolved raw material and crystals separated from the molten glaze, together with weathering products.

Most of the studied glazes are characterized by Na_2O contents in the range of 8-13% and relatively high MgO and K_2O contents, both generally above 3%; however, some Parthian and early Sasanian glazes show a mixed alkali composition with Na_2O contents in the range of 6-8% and K_2O contents around 5% or higher. These data point to the use of different kinds of plant ash as a flux.

Iron is the only colouring agent found in yellow and yellow-green glazes, while blue, blue-green and green glazes contain both copper and iron; EDS data indicate that a progressive shift from blue to green hues is matched by a decrease of the Cu/Fe atomic ratio. Fe_2O_3 contents generally higher than 1% would point to the use of an impure silica source; however, the analysis of relics of undissolved material suggests addition of haematite in some early and middle Sasanian glazes with Fe_2O_3 contents exceeding 2%. Inclusions of SnO_2 further point to the use of bronze scraps in the production of copper containing glazes (1-4% CuO).

The surface of the internal glaze of a Sasanian sample features a peculiar red hue; SEM images reveal the presence of a 2-3 μm thick layer at the glaze surface, whose composition suggests the presence of elemental copper as the colouring agent.

L-30

CERAMIC PRODUCTION IN ISLAMIC SMALL KINGDOMS (TAIFAS) OF THE IBERIAN PENINSULA: THE CASE OF ALBARRACIN (TERUEL), 11TH – 12TH CENTURIES AD

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As part of a large project on ceramic production in Islamic Taifas (small kingdoms in the Iberian Peninsula during last periods of Muslim political authority), pottery found in Albarracin (Teruel, Spain) was studied in order to know the main characteristics and influences of the ceramic manufacture in the area, with examples of tin-glazed, coloured-transparent-glazed and slip-decorated pottery.

Albarracin Taifa (in the south of the current Aragon region) was an independent kingdom since the beginning of the 11th century AD. During this Taifa time, the small town showed a splendorous cultural and economic period, with prosperity and refinement similar to other important towns in al-Andalus (Muslim Iberian Peninsula). In 1170, Albarracin territory was passed to Christian hands, but still preserved some independence for a century. This privileged position during more than two centuries helped Albarracin to maintain economical contacts with Muslim areas along with Aragon and Castilla, and while maintaining advantageous cultural relations.

These cultural features of the Albarracin Taifa led its ceramic production to be considered very interesting in terms of pottery characteristics and actual exchanges between different workshops in the 11th-12th centuries. Fragments of non-glazed and glazed pottery were analysed by ICP-Atomic Emission Spectrometry, and slips and glazes were studied by Scanning Electron Microscopy with Energy Dispersive X-ray Spectrometry. The knowledge of raw materials was completed by the investigation of lead-isotope ratios by ICP-Quadrupole Mass Spectrometry. Results from some of the most interesting ceramic types will be presented in order to emphasize principal differences and similarities between them in relation to other Islamic areas (like Zaragoza, Valencia or Murcia).

L-31

GILDED MEDIEVAL ISLAMIC GLAZED CERAMICS : PRODUCTION PROCESS AND EVOLUTION IN THE IRANIAN WORLD (12TH-13TH C.) AND THE TIMURID EMPIRE (14TH-15TH C.)

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Timurid architecture is characterised by façades entirely covered with glazed ceramics. Some of them present a specific decoration made of gold leaves. This technique seems to have been imported from the Iranian World with the potters Tamerlane deported to Samarkand and Kesh – his hometown – during his military conquests.

The first aim of this paper is to determine the main steps of the production process of such a decoration. To reach the information, non destructive analyses have been privileged such as SEM-EDS and PIXE so as to determine whether the gold used was alloyed or not. RBS estimates the width of the gold leaf and determines the nature of the different layers as well as the roughness of the interface. The surface roughness of the virgin glaze, the gold leaf decoration and the glaze that used to be gilded are studied by white light interferometry. Surface XRD pole figures are of very high interest as they give information not only on the mechanical treatment but also on the thermal treatment of which the gold leaf underwent in the past.

Then, another issue of the study is to compare the data obtained on gold leaf decoration coming from Timurid tiles (14th-15th c.) with Iranian sherds dating from 12th-13th c. showing the same kind of decoration. This will enable to conclude whether it is the same production process, and if so, what its evolution was in its well-defined geo-chronological context is.

L-32

LUSTRE AND LUSTRE TECHNOLOGY IN SPAIN - COMPARISON BETWEEN ANCIENT PRODUCTIONS FROM PATERNA (OLLERIES XIQUES 13TH TO THE 15TH CENTURY) WITH MODERN ARTESIAN PRODUCTIONS

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Lustre is a medieval ceramic decoration that corresponds to a nanostructured thin layer formed by metallic copper and silver nanocrystals embedded in a glass matrix which required deep knowledge from the artisans on the raw materials used and on the kiln conditions. Their empirical knowledge lead to the achievement of colourful lustre decorations ranging from reddish to yellowish or even greenish, some of them with a metallic shine with a purplish iridescence. Lustre ceramics dating from the 13th century from *Olleries Xiques* workshop in Paterna (Spain) have been studied linking their chemical composition and nanostructure with their colours and shine and compared to modern lustre productions in a modern workshop in the Valencia region. In ancient lustre two kinds of nanostructures are found, yellowish lustre decoration constituted by silver metal-glass nanocomposite, and reddish lustre decoration constituted by metallic copper nanocrystals and copper oxides nanocrystals. In some cases metallic copper nanocrystals covered with an oxidized shell of CuO and partly Cu_2O have also been found. In modern lustre productions only metallic copper nanocrystals are found developing a fully metallic appearance at the end of the production process. Although the aesthetic differences, related to colour and shine, appeared between the ancient and modern productions, this detailed study demonstrates that the production technology in both cases is the same, and shows that differences seem to be linked, in the first place to the raw materials used (silver or copper), and in the second place to the annealing conditions (reducing atmosphere, time and temperature) during the production process.

L-33

HIGH-MG FAIENCES FROM GRANGES-LE-BOURG (HAUTE SAONE, FRANCE)

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Usually, French tin-opacified lead glazed (enamelled) pottery is poor in MgO. However, there are some MgO-rich (H-Mg) faience pieces whose manufacturing technique and origin remain unclear, despite the fact that high MgO-contents can be observed in some pieces attributed to Varages (southern France). H-Mg composition can be caused by the use of dolomitic or montmorillonitic raw material, or the admixture of ground soapstone, magnesite or dolomite to a MgO-poor clay.

Archaeological excavations of the brickworks at Granges-le-Bourg started in 2002. According to archive entries, they were active from the 16th to the 19th c. Faience waste was found from an unknown, not yet documented, late 18th/early 19th c. production. In Granges-le-Bourg, coarse, as well as fine ceramic was therefore produced simultaneously. Archaeometric analysis included 40 faiences (biscuit and enamelled pieces), 21 samples of technical ceramics (saggars and spacers), 5 bricks or tiles, 7 clays and 3 frits. Analytical techniques were optical microscopy, X-ray fluorescence, X-ray diffraction and scanning electron microscopy, coupled with an energy-dispersive X-ray spectrometer (EDS).

The faience is rich in MgO (5-10 wt %) and can be distinguished clearly from known reference groups. It represents the first original French H-Mg faience reference group. Astonishingly, there is a chemical match between the spacers and the faience, while the saggars and the bricks and tiles are magnesium-poor. Local Triassic (Anisian) marls contain much dolomite and are chemically similar to the H-Mg faience. As shown by vertical profiles of two raw materials outcrops, there is a decarbonatisation towards the surface. The top layers correspond chemically well to the MgO-poor ceramic group. Firing temperatures lie < 800°C for the biscuits and between 950-1050°C for the enamelled pieces, indicating a two chambered kiln. The quality of the tin glaze is not very high, showing many rounded quartz crystals, bubbles and inhomogeneously dispersed cassiterite crystals, forming clusters. No reaction zone between glaze and body was observed. A coating of either tin glaze (with significantly less tin oxide than in the faience pieces) or lead glaze has been applied to the interior of the saggars. For these objects a glaze-ceramic body interface has been observed only for the lead glaze.

L-34

NON-DESTRUCTIVE CHARACTERIZATION OF CAPODIMONTE AND BUEN RETIRO PORCELAIN GLAZES BY MEANS OF RAMAN SPECTROSCOPY

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Raman spectroscopy has long proved its effectiveness in the non-destructive characterization of pottery and porcelain pastes and glazes, as it allows a rapid and fairly straightforward identification of both crystalline and amorphous phases through the excitation of their molecular vibrational levels. The Raman spectra of silicate glasses (such as ceramics glazes) can be additionally treated in order to extract valuable information about their composition and firing temperature, which can in turn be related to the production technology of the studied artefact. Further methodological developments can be made in the structural interpretation of the spectral features of glasses, and in the establishment of definite relationships between them and the chemical composition, opacification and colouring means of the glass itself.

Raman analyses have been carried out on both transparent and opaque glazes of 18th century porcelain fragments excavated near the ancient manufactures of Capodimonte (Naples, Italy) and Buen Retiro (Madrid, Spain). The Capodimonte factory was established by Charles III of Bourbon in 1743 while he was king of Naples; when he became king of Spain, in 1759, the manufacture was dismantled and all personnel and materials moved to Madrid, where the Buen Retiro production was started.

Two instruments have been used for Raman analysis: a Dilor XY2 spectrometer in macroscopic configuration, using a 406.7 nm Kr^+ laser and a CCD detector, and a Jobin Yvon Labram Infinity coupled with a 50x microscopic objective, Nd:YAG laser at 532 nm and CCD detector. Interesting comments can be made on the possibility of comparing spectral data acquired with different instruments.

L-35

ARCHAEOMETRICAL ANALYSIS OF NEOLITHIC POTTERY AND COMPARISON TO POTENTIAL SOURCES OF RAW MATERIALS IN THEIR IMMEDIATE ENVIRONMENT – AN OVERVIEW

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Pottery, daub and soil samples from ten Neolithic sites throughout Hungary were investigated by mineralogical, petrological and geochemical methods (Vörs, Tihany, Kup, Aggtelek, Felsővadász, Borsod, Tiszalúc, Füzesabony, Tiszaszőlős and Szarvas-Endrőd). Clay deposits in the vicinity of these sites were also sampled and studied. More than 300 sedimentary/soil samples were taken by drilling and described macroscopically, about 130 samples were characterized petrographically. From 173 sherds and geological samples major and trace elements were analysed by XRF, partly also by INAA. XRD was carried out on about 100 samples for mineralogical information.

Our investigations can be regarded as the first large scale comparative study on early pottery production and their potential raw materials. The most important observations are:

- the raw material of pottery and burnt wall debris (daub) is characteristically different at most of the localities. Chemical composition of daub is closer to that of the local soil and has typically a high phosphorous content, due to the admixture of organic material.
- the geochemical pattern of the pottery of individual sites ("fingerprint") is different by site and region.
- the raw material in the pottery can be different from the soil locally but related to local clay deposits (e.g. Vörs). Sometimes higher Al concentrations show that soil varieties with a higher clay and mineral concentration were chosen. In the case of some sites, the soil composition and the daub and pottery compositions are close to each other (e.g. Szarvas-Endrőd, Füzesabony).
- among the Neolithic samples investigated so far, no pieces of foreign origin have been encountered. However on multi-level sites some non-Neolithic samples (e.g. Bronze age, Borsod) may be of foreign origin.
- at some sites from the Bükk-culture (e.g. Aggtelek, Felsővadász), pottery samples show very complex chemical patterns with (possible influence) of cave clay and temper of bat-dung, quartzite and others.

The data were organised into a database that will be accessible on the project homepage.

L-36

LATE-REPUBLICAN GREY WARE FROM BASILICATA AND APULIA (SOUTHERN ITALY, 2ND – 1ST CENTURY BC)

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The Grey Ware is a late-Republican ceramic production attested in many South Italian settlements dated from 3rd to 1st century BC. Previously known as "Campana C", it is characterized by a typical grey to black "glaze" and shows homogeneous formal features (mainly open plates and cups). This study provides the first petrographical, mineralogical (PXRD), and chemical (XRF, FeO titration, SEM/EDS) inter-site characterization of 89 Grey Ware samples from four different late Republican settlements of Difesa San Biagio (Montescaglioso), Piano della Civita (Tricarico) and Matera in Basilicata and Iesce (Altamura) in Apulia. The aim of the archaeometric analyses is to verify the hypothesis of a local production of this ware in many inland settlements of Basilicata and Apulia. Twelve samples from the clay deposits of "Argille subappennine" and three of "Argille varicolori" that were cropping out in the proximities of the sites have been compared to the pottery samples.

Two petrographical groups ("A" and "B") with different grain-size distribution and composition have been distinguished. Both groups share calcareous matrix and relatively high content of Fe-oxides. Group B can be distinguished from Group A for a coarser texture and for the occurrence of calcite and fossils as non-plastic inclusions. The two groups show high chemical homogeneity.

"Argille subappennine" are calcareous clayey silts with prevalent illite as clay mineral. The "Argille varicolori" smectitic clays have suitable iron content because of pyrite, but they are not calcareous. Although "Argille subappennine" are geochemically consistent with the grey paste samples, their Fe_2O_{3tot} content is lower than that of the ceramics. Chemical and mineralogical analyses conducted on the fine fraction (< 2 μm) of Argille subappennine showed that Fe_2O_{3tot} content increases and CaO decreases compared to the bulk sample. This may prove that elutriated "Argille subappennine" were used to make the ceramics of Group A, whereas bulk clay samples with much calcareous sand and fossils were used for the ceramics of Group B. Chemical homogeneity and good match of Group B with "Argille subappennine" clays from Tricarico, point to this as common production site in Basilicata.

Grey paste was obtained with reducing firing atmosphere. The mineral assemblage points to firing temperature range between 850 and 1,050 °C. Black slip is well vitrified and homogeneous (SEM/EDS).

L-37

ROMAN AMPHORAE AROUND THE CHANGE OF ERA: PRODUCTION AND CONSUMPTION PATTERNS IN THE NORTH-EAST OF THE IBERIAN PENINSULA

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During the 1st century BC the *Citerior* Roman province (nowadays Catalonia, Spain) developed an agricultural production system focussing on the production of a surplus for export. This surplus, generally assumed as wine, was transported by amphorae produced in the same province. In this regard more than 50 amphorae production centers have been recovered along the Catalan coast producing several Roman amphorae designs used for the transport of wine. These Roman types, derived from Greco-Italic tradition, replaced the Iberian types derived from the Punic one. Specifically, the first Roman amphora design concerned, the Dressel 1 type, was produced during the first half of the 1st century BC. Later on, during the second half of that century, two new amphorae designs characteristic of the Catalan area were introduced and widely produced: Tarraconense 1 and Pascual 1.

To date 350 amphorae recovered from several production and consumption centers of the northern part of the Catalan area have been analyzed. The analytical program has been carried out by a combination of techniques. The chemical composition has been determined by XRF and mineralogical characterization has been achieved by XRD. In some cases SEM has been used to characterize the microstructure and sintering stage of the matrix. Additionally, several mechanical properties tests have been performed on these types of amphorae in order to study the strength and toughness of the material. The materials properties have been studied for the very first time together with the different shapes of these amphorae by Finite Element Analysis. This method enables us to evaluate the different designs determining the mechanical performance of the vessels under different kind of loads and simulating transport conditions.

The present work reports on the results that have so far revealed different technological patterns among different workshops and, in some cases, within the same workshop during its activity period. The archaeological implications of these findings are discussed in the view of production and distribution of wine in the studied sites.

L-38

DOES LOW QUALITY RELATE NECESSARILY TO LOCAL PRODUCTIONS AND LIMITED TRADE? THE TERRA SIGILLATA "A PRODUCTION" FROM THE NAPLES BAY

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Recent archaeometric research on sites on the Catalan coast, in the western Mediterranean, has shown the large presence of the terra sigillata "A Production" from the Naples bay. The archaeological information enables us to identify the consumption of this pottery dating back to the beginning of Augustan period to the first half of the first century AD. From the typological point of view, their shapes are the same as those exhibited by the products of Italian *sigillata.* However, they clearly differ from Italian *sigillata* on the grounds of their visual appearance. As a consequence, it is always considered local and it is never included in the provenance studies as a veritable Italian *sigillata*, even if its presence allows dating strata and establishing trade networks between Italian Peninsula and several archaeological sites.

The analytical study of this group of pottery included chemical and mineralogical characterization by means of X-Ray Fluorescence and X-Ray Diffraction as well as study of microsctructe by Scanning Electron Microscopy. The data enabled us to locate the provenance of this group, by comparing with reference material, to the Naples bay. At the same time, the SEM and XRD results combined revealed low firing temperatures for all A Production members.

These results highlight the phenomenon related to sigillata produced in convection kilns, as opposed to the high temperature ones, fired in radiation kilns. The widespread distribution of this A Production and the fact it comes from Naples bay does not fit with the general assumption of local imitations for sigillata produced in such convection kilns.

L-39

GEOCHEMICAL FINGERPRINTING OF ROMAN POTTERY PRODUCTION FROM MANTA ROTA KILNS (SOUTHERN PORTUGAL)

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The Roman site of Manta Rota, located in Algarve region, Portugal, is known from the XIXth century when Estacio da Veiga recovered a few pottery fragments and identified the foundations of Roman structures. References in early XXth century refer to a pottery kiln and to the remains of both amphorae and lamps.

In 1992, emergency excavations directed by Cristina Garcia excavated a structure identified as a kiln and recovered abundant amphorae fragments of a locally produced Dressel 14 type. There is evidence of production of tiles, common wares and amphorae. The study of the remains collected (terra sigillata and amphorae) in the excavations shows that Roman occupation of the site covers a period from the middle of the 1st century until the 5th century AD. The major production of the kiln area was the Dressel 14 fish sauce amphora centered in the middle/second half of the 1st century but the production of Almagro 51c is also attested. A preliminary macroscopic analysis of both the amphorae and the common wares show identical features. The aim of this paper is to present chemical characterization of the production of Manta Rota and to compare the results with different workshops in the Algarve region as Quinta do Lago, near Faro or S. Bartolomeu de Castro Marim, in the proximity of the studied area, in order to establish geochemical fingerprints of Manta Rota ceramic production center.

Preliminary results point to a fine geochemical differentiation of the Manta Rota ceramics in comparison with the other two roman production centers of Algarve region.

L-40

CERAMIC PRODUCTION TRADITIONS IN THE LATE BYZANTINE–EARLY ISLAMIC TRANSITION: A COMPARATIVE ANALYTICAL STUDY OF CERAMICS FROM PALAESTINA TERTIA

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The Byzantine period was an era of flourishing agricultural towns in southern Transjordan and the Negev. These areas belonged to the Byzantine province of Palaestina Tertia and were connected by various trade routes and an intensive trade network. However, many of the centres in the area were in decline already prior to the Muslim invasion in ca AD 630, after which many of the cities seem to have been abandoned. At the same time, changes in trade patterns emerged. In general, we have only limited information of the cultural and economic situation in these areas following the Muslim invasion. The Byzantine ceramic workshops in the area known to date cease to function by the end of the 6th century AD, thus the nature of the local ceramic traditions, and their possible continuation during the early Islamic period, are not well-known.

ED-XRF, SEM-EDS and petrographic analyses of ceramics from late Byzantine–early Islamic sites in the area were carried out in order to study the ceramic production and distribution patterns, and to enlighten the overall cultural and economic picture. The archaeological sites, Jabal Harûn (Petra), Khirbet edh-Dharih, ‘Aqaba, Elusa and Abu Matar (Beersheva), representing rural, urban, and ceremonial sites, cover different socio-economic contexts across the area of the former Byzantine province.

The results show that despite the decline of the cities and the abandonment of the known Byzantine workshops, the local ceramic productions seem to continue in well-established form also in the transitional–early Islamic period. Food containers and some glazed ceramics appear to be the only exotic ceramics, while the bulk of the pottery was obtained in local markets. Interestingly, the lack of long-distance trade of ordinary ceramics did not preclude the imitation and transfer of styles, as the ceramics from the former Palaestina Tertia share general stylistic features typical of the early Islamic period despite the administrative changes. It thus seems that local potters adapted to new cultural and stylistic influences, reflecting the socio-economic transformation in the area: even though historical sources give the impression of a general decline, the Byzantine centres continued to function as rural market places. Altogether, the study of ceramics sheds new light on the cultural and economic dynamics of the transition period in the region, for which relevant information was scarce.

L-41

CERAMIC PRODUCTION IN MEDIEVAL IFRÎQIYA: LOCAL PRODUCTIONS AND FOREIGN INFLUENCES AS SEEN IN THE CASE OF SABRA AL-MANSÛRIYA

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Recent excavations undertaken by a French-Tunisian expedition, directed by P. Cressier (CNRS-Université Lyon 2) and M. Rammah (INP, Kairouan), gave the opportunity to reconsider the question of ceramics production in Sabra al-Mansûriya, a dynastic capital founded in the Fatimid period at the gates of Kairouan (Tunisia). Local production is attested by a kiln and associated kiln furniture and wasters. Mineralogical, petrographic and elemental analyses of pastes and glazes - carried out by optical microscopy, SEM-EDS, XRD and WD-XRF - enabled us to establish and to characterize reference groups, helped identifying the range of locally manufactured wares and gave information about production techniques.

Besides the turquoise- and opaque white-glazed wares found among the wasters, analyses suggest the manufacture of green and brown painted wares ("vert et brun") and lustre wares in Sabra. The latter are found together with imported lustre wares of at least two types (one manufactured with a clay paste and another with a synthetic paste or stonepaste). The former find their place in the regional productions of "vert et brun", whose best known representative is the so-called "jaune de Raqqâda" of the Aghlabid period. However, no evidence of local production in the medieval period has been found so far in the neighbouring site of Raqqâda.

Our study expects to bring some new elements, based on reliable archaeological material, on the role of Sabra al-Mansûriya both at the regional level and within the Fatimid empire, especially regarding its connections with Egypt.

L-42

THE MAJOLICA PRODUCTION OF NORTHERN-CENTRAL SICILY (16TH - 18TH CENTURY AD): ARCHAEOMETRIC EVIDENCE

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Collesano and Polizzi Generosa are considered among the most important historic centres of the Madonie, a mountainous area located at the northern part of central Sicily. Ceramic workshops dedicated mainly in the production of tiles and various wares are present in this area since the 12th century as attested in the historical records. At Polizzi Generosa the majolica art had flourished between the 15th and the 16th century and reached very high levels of expression before it regressed and finally ceased during the first two decades of the 17th century AD. On the contrary, at Colessano the majolica production reached its apex between the 17th and the 18th century AD. Both the historical records and the historic-art studies have demonstrated that the majolica manufactures produced at Polizzi Generosa and Collesano were widely circulated in western Sicily and, moreover, were being exported to Palermo.

The object of the present contribution is the mineralogical, petrographic and chemical study of representative samples of the aforementioned manufactures. Thin section examination and X-ray fluorescence analysis of their ceramic body have allowed to characterize the fabric of the local productions and to reconstruct many details of the production cycle. This task was accomplished through the comparison with series of data previously acquired, following similar analytical protocols, from raw materials which were traditionally utilised by the local craftsmen. Furthermore, the laboratory research has been expanded in order to include the enamelled surface, aiming to individuate the pigments used for the decoration motifs of the pavement tiles (black, dark green, light green, yellow, sky-blue). For this second task, XRD, FTIR and SEM/EDS were the analytical techniques which were called into play.

L-43

INKA CERAMIC MANUFACTURE: IMPERIAL STANDARDIZATION, LOCAL PARTICULARITY AND IMPORTATION

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This archaeometrical research deals with the investigation of Inka Period (A.C. 1450—1535) pottery from Paria, an Inka administrative centre in the Department of Oruro, Western Bolivia. Since this settlement was found in the Southern part of the great Inka Empire, which is much less known than those found in the heart of the empire (vicinity of Cuzco), the archaeological excavation going on here requires special attention. Paria was established at the intersection of two important imperial roads so it could have played a significant role in the Inka Empire.

During the field excavations different archaeological pottery types were found. These can be distinguished a classical Inka imperial type, a lower-quality type (Inka local and late pre-Inka style) and an outsider type of ceramics with a different appearance.

A three year long archaeometrical investigation fulfilled a comprehensive petrological-mineralogical-geochemical analysis of a representative part (more than 300 pieces of pottery) of the ceramic assemblage. The main goal of the reasearch was the comparison of ceramic types from the point of view of provenance and technology (fashioning, surface treatment, firing). It was an important question whether it is possible to assess differences in the material of the archaeologically separated ceramics. This part of the study could provide information about the local and non-local raw materials of pottery and some potential sources for materials in the vicinity of the archaeological site.

During the petro-mineralogical research, archaeological finds, local alluvial sediments and hard rocks (45 geological samples) were investigated. On the base of these fundamental results and applying a statistically valuable amount of sample it was possible to utilize comparative geochemical (INAA, XRF) methods to confirm the petrographic classification. Investigation of technological aspects was fulfilled by XRD, SEM and EMPA methods.

On the basis of the petrographic observation of the Inka Period ceramics we were able to create three main petrographic group of pottery: (1) volcanic/volcanoclastic derived type, (2) sedimentary derived type and (3) metamorphic derived type. The (1) petrographic type covers the Inka imperial type ceramics, while the (2) group represents the lower-quality type and the (3) group is the outsider (non-local, imported?) type ceramics. According to their provenance it can be stated that the near-local volcanic/volcanoclastic formations of the area (5-30 km from the site) could have been a potential source for the raw materials of the (1) petrographic group. The local (1-5 km from the site) Palaeozoic shales-siltstones-sandstones could serve to provide raw material for the (2) petrographic group. While the absence of genuine metamorphic rocks in the vicinity of Paria suggests that the (3) petrographic ceramic group probabily arrived there by some commercial way.

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P-01

THE NON HOMOGENEOUS RAW MATERIALS IN PROTOHISTORIC POTTERY: THE IMOLA CASE STUDY COMPARED WITH OTHER PRODUCTION

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Prehistoric and protohistoric pottery is characterized by the abundance of temper and the non homogeneous composition. This coarse pottery, the so-called "impasto", is the main production from Neolithic to Early Iron Age.

Archaeometic analyses of Bronze Age pottery (2nd millennium B.C.) from San Giuliano di Toscanella e Monte Castellaccio (Imola) show the use of very corse raw materials with calcareous fragments, "Argillaceous Rock Fragments", "Clay Pellets", siltsones, and "grog". This composition appears mainly as a result of the use of alluvial soils without levigation.

We present the results of the comparison between Imola pottery compostion and other vessels produced in other contemporary Italian sites. The discussion focuses on the similarities and the differences between these coarse products. The comaparative ceramics are from Broglio di Trebisacce (CS), Coppa Nevigata (FG) e Malta: they are produced in different geological areas but all characterized by a prevalent sedimentary composition.

The most common tempers are sedimentary rocks (siltstone, sandstone, calcite) at Broglio di Trebisacce and Monte Castellaccio, Argillaceous Rock Fragments, at Coppa Nevigata, Malta, San Giuliano di Toscanella and Monte Castellaccio. Grog is abundant at Malta, San Giuliano di Toscanella and Coppa Nevigata.

We conclude with a discussion about a specific methodology for the study of compositional and structural aspects of these products, which is different from the finer production of the historical phases.

P-02

POSSIBILITIES AND LIMITATION OF MACROSCOPIC DETERMINATION OF POTTERY FABRICS IN THE FIELD

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Many proposals were made how to describe pottery fabrics in the field and there is a lot of experience of many groups of archaeologists working in different regions. But in many instances later archaeometric analysis done to check the fabric groups from field showed large discrepancies and the fabric groups classified in the field were not confirmed. If the laboratory test was not made in the beginning of the field work later corrections of the previous pottery classification mostly is impossible. Therefore, and also in cases when a large number of samples can not be taken to a laboratory e.g. to another country for archaeometric analysis, a fabric classification and documentation in the field is necessary. Modern digital cameras offer a cheep and quick possibility to make a photo of a fresh break. This could be done with thousands of sherds. Later thin sections studies, refiring (MGR-analysis) and chemical analysis can be made on a few sherds and then correlated with the appearance in the fabric photo. This is tested using examples on a basis of 500 sherds from Neolithic to Islamic periods collected during archaeological field surveys in Oman and analysed in the laboratories in Berlin and Warsaw (project was paid by DFG). For the laboratory analysis a down-up sampling strategy was used starting with 500 MGR-analyses, followed by selecting 70 samples for chemical analyses by WD-XRF and 52 samples for thin sectioning.

P-03

IMPORTED CERAMICS AT TROY IN THE 2ND MILLENNIUM BC – MICROSCOPIC ANALYSIS

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This presentation is an overview of some of the ceramic imports from Troy at the end of the Middle Bronze Age and through the Late Bronze Age. The number of imported pottery at the site has never been large, but they represent an astonishing abundance of fabrics, undoubtedly imported from different localities in the Eastern Mediterranean. The research conducted by the authors during the last couple of years has confirmed the assumption on the domination of western over eastern (in relation to Troy) ceramic imports in Troy during the Sixth Settlement. Several locations in the Eastern Mediterranean have been preliminarily identified as potential sources of the imports; macroscopic observations have been combined with petrographic analysis. The latter method proved to be a powerful way of characterizing different sherds grouped by archaeological criteria. In case of some rarely represented sherds electron microprobe analysis helped to obtain more precise information about chemical composition of different, mostly magmatic, rock fragments found as natural and/or artificial temper in the ceramics. The data allowed us to refine our knowledge base about the provenance of the materials in question.

P-04

ELECTRON MICROPROBE ANALYSIS FOR ARCHAEOCERAMICS

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The use of the Electron Microprobe for studying archaeological ceramics is not widely applied, even though it enables the identification of mineral compounds of the matrix, temper grains, minerals originated during firing or post-depositional alteration products. In turn, the detailed knowledge of the mineral phase composition allows inferences of the classification of shards, the identification of raw materials and the technological conditions of firing.

Apart from the obvious advantage, several problems are inherent to the method. Among these, the most obvious is the low total sum of the quantitative analyses. This can be due to various factors, such as: the fine porosity of samples, the incomplete dehydroxylation during the firing, or the rehydration and/or rehydroxylation during the burial.

Another problem is related to the identification of mineral components of the clayish matrix, as it represents a more or less homogeneous mixture of extremely-fine grained minerals, usually smaller than the beam diameter (3-5μm). The presence of an amorphous or vitreous phase complicates the situation.

The distinction among the primary and the secondary (firing) phases can also be relatively difficult, as the same mineral may occur as both. And the last but not the least, the minerals originated during firing represent basically metastable phases, with non-stoichiometric composition, difficult to be characterized from a mineralogical point of view. Additionally, they are "contaminated" with elements such as Fe, K or P trapped inside the new lattice.

The above discussed situations are illustrated by case studies of archaeological ceramics from Transylvania (Romania).

P-05

THE PALATINE EAST POTTERY PROJECT: A HOLISTIC APPROACH TO THE STUDY AND PUBLICATION OF AN EXCAVATED POTTERY ASSEMBLAGE FROM ROME

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This poster presents an overview of the methodological procedures being employed by the Palatine East Pottery Project to study and publish the 12 tons of Roman pottery recovered in the Palatine East Excavations in Rome. A combination of traditional and innovative procedures is being used for the classification, characterization, quantification, and presentation of the materials. The classification of materials is being undertaken on the basis of fabric, while the form typology is based on a combination of morphology and forming procedures. Fabrics are defined by examining large numbers of examples under a low-power microscope, with petrographic analysis employed to refine fabric descriptions. A program of NAA is also being utilized to partition the regionally-produced wares manufactured from fine-bodied marine clays and to match these with source clays. In order to provide for maximum intercomparability with the results from other projects, the materials are being quantified by a battery of techniques, including sherd count, weight, minimum number of vessels, and estimated vessel equivalents. To allow the data pertaining to transport amphorae to be converted into more meaningful figures a CAD-based routine is being used to calculate the mean volume of the various amphora classes represented on the basis of profile drawings. Various data sets are being prepared for intermediate publication on the internet, while the final paper publication will present several forms of data on a CD-ROM insert. The final result will represent a methodologically ambitious exposition of a large assemblage of material spanning the entire period of the Roman empire.

P-06

APPLICABILITY OF PROMPT GAMMA ACTIVATION ANALYSIS TO THE ARCHAEOMETRY OF POTTERY

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According to our first experience, Prompt Gamma Activation Analysis (PGAA) is well suited to pottery archaeometry. PGAA is a non-destructive bulk analytical method, capable of determining concentrations of most of the major- and some trace components. Without sampling an object we are able to quantify its major components (SiO_2, TiO_2 Al_2O_3, Fe_2O_3, MnO, MgO, CaO, Na_2O and K_2O). In most cases accessory and trace element concentrations like B, Cl, Sc, V, Co, Cr, Nd, Sm, Eu and Gd can also be determined.

In the course of proficiency studies, selected objects have been analysed with PGAA, XRF and INAA too. As an outcome the agreement between the PGAA and XRF data are good. Although XRF exhibits a better sensitivity to most components, PGAA provides the additional possibility to determine the concentration of B and H.

With the help of H (i.e. H_2O) measurements, the effect of firing on the composition of clay can ideally be tested, as it is demonstrated.

In this paper, we give examples of our PGAA investigations on ancient ceramics.

As part of an occasional co-operation with the Simón Bolívar University, Caracas, we have investigated pre-Columbian ceramics figurines found in Venezuela. Based on some significant element ratios and also on Principal Component Analysis of the data, one can clearly distinguish between the objects of two different provenances.

Within the frame of the MÖB-DAAD project that aimes to investigate Hungarian Neolithic pottery, we have analysed pottery fragments and soil samples from the settlements of Szarvas-Endrőd and the Tiszalúc region (South-East Hungary and North-East Hungary, respectively) – see Taubald et al., in this Conference.

We took part in a Proficiency Test – organized by the IAEA – on Chinese porcelain reference sample that has resulted in the following outcome: all the identified components with PGAA agreed with the reported target values, excluding Na, which we have quantified with a significant deviation from the target value.

P-07

HOW USEFUL IS NEUTRON DIFFRACTION FOR STUDYING ARCHAEOLOGICAL CERAMICS?

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Time-of-flight neutron diffraction can be used to non-destructively determine the mineralogical compositions and structural properties of materials [1] such as ceramics, metals objects and pigments. Neutrons interact weakly with matter and penetrate large volumes of material without substantial loss of intensity. Hence, a truly quantitative analysis of the mineral phase contents, crystal structures, textures and strains of intact objects can be achieved, without the need for taking samples. Moreover, the information gained is representative of a large part of the object. In the past few years, there have been a number of neutron diffraction analyses on archaeological ceramics at the ISIS pulsed neutron source at the Rutherford Appleton Laboratory, UK. This paper surveys on the range of materials and objects that can be studied with neutron diffraction, such as pottery fragments, complete museum artefacts, ceramic seals and casting cores hidden inside metal objects. It is now time to take stock of these diverse projects and to summarize advantages and drawbacks for research on archaeological ceramics, to assess the usefulness and problems of the method in terms of information content, analysis of large sample series, and effects of the neutron radiation. A critical assessment of the neutron diffraction method is given, with an outlook of how to better utilize the tool to answer questions of archaeological significance.

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P-08

VIBRATIONAL SPECTROSCOPIC STUDY OF LATE NEOLITHIC PAINTED CERAMICS FROM SZOMBATHELY-OLADI PLATÓ (WESTERN HUNGARY)

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During the excavations in the years of 2006 and 2007 at 'Szombathely–Oladi plató' (western Hungary) a settlement of the final Neolithic, the earliest Lengyel Culture was found. This period is characterised by polichrome (various shades of red, yellow and white) painted pottery. An important site at 'Sé–Malomi dűlő' also represents this period. Since we have a very poor knowledge about the minerals used as pigments and about the techniques used to fix them on the vessel walls, we decided to apply various chemical and physical analyses to answer our questions.

The identification of pigments on archaeological materials is fundamental for understanding an object's history, to verify their authentication, solving certain restoration and conservation problems. Our investigation strategy was based on the techniques using infrared and Raman spectroscopy to study the mineral (and possibly organic) content of the samples, backed up by other techniques, like scanning electron microscopy (SEM). Raman spectroscopy (FT-Raman and microRaman), together with FTIR microscopy are extremely effective in studying archaeological materials due to their non-destructive, non-invasive properties, allowing *in situ* measurements of samples like decorated pottery fragments and paint nuggets.

We also investigated raw materials of pigments, found at the excavation site, which were supposed to be similar to the ones applied on ceramics. One piece of red ochre pigment was identified as pure haematite. On ceramic fragments, however, the coloring component of the red decoration was found to be mercury sulfide (HgS), mixed with kaolinite. Both IR and Raman measurements, and elemental analyses carried out by EDX support this observation. The homogeneity of painting applied to the vessels, demonstrated by FTIR microscopy, suggests that the components were mixed before the paint was applied to the surface of the vessel. The white painted parts consist of pure calcite.

A more detailed analysis and spectral interpretation could also provide information regarding the painting techniques and possible binding materials. All this information, together with the identification of analytical compositions may lead to an assignment of historical and geographical provenance.

P-09

A MULTIVARIATE TECHNIQUE TO ANALYSE STYLISTIC VARIATIONS IN THE POTTERY ASSEMBLAGE – A CASE STUDY FROM AN IRON AGE CEMETERY OF SARM, NORTH CENTRAL IRAN

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The study of pottery assemblages gives valuable information in archaeology as both cultural and chronological indicator. This study describes an Iron Age burial site of Sarm, north central Iran, where 80 graves were excavated and a total of 1282 pots in combination with other grave materials have been registered during the 3 years of excavation from 2001 to 2003. Compared to other cemeteries in the area Sarm stands out as the most important burial site between 900 -1500 BC, with an extremely large, rich and well-documented assemblage. The focus of this work is on two specific and interrelated aspects of burial habits in particular pottery and burial rites. The work has been performed in a systematic manner using a combination of simple descriptive statistics and more complex exploratory multivariate techniques particularly correspondence analysis. The techniques were used to identify type compositional characterization of grave goods (1) to identify types or groups that can be clearly differentiated from other groups to reveal a meaningful archaeological interpretation, (2) to investigate whether there were variations in the type of graves and whether a classification could be used as a basis for an explanation of ritual patterns. Through pattern recognition and statistical analyses, we need to consider possible correspondence between and among the analytical units and ultimately among the various grave types. During this process we would define some of the cultural parameters that shaped burial rites and identify and assess observable patterning that links the pottery styles, grave materials and ultimately burial rites. The results of these quantitative examinations were then investigated to determine if any new patterns could be noted in the data. In general, this study suggests a clear picture of interrelationships in the data and has led to prove the method to address more theoretically oriented questions.

P-10

A NEW DATABASE OF ANCIENT POTTERY PRODUCED IN ITALY

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The aim of this poster is to inform in outline about a project recently set up, and still under way, concerning the creation of an integrated multimedia database, gathering archaeological and archaeometric data (chemical, XRF –X-ray Fluorescence- and mineralogical, polarization microscope) on ancient pottery produced in Italy: a fundamental tool for researchers to be consulted on-line as a web application (structure by CILEA, Milan).

The main objective of the data bank is to make the archaeological and archaeometric researches, concerning the production and diffusion of Italic pottery, in Italy and out of Italy, easier.

The data bank consists therefore of data non accidentally assembled, but drawn from targeted researches aiming at the solution of archaeological questions concerning production and diffusion.

Main themes of the data bank are:

- the production and technology of the fine Roman wares in the Mediterranean, in particular the black gloss ware; or the production of some groups of common ware, whose diffusion goes beyond the local/regional area;
- the production and diffusion of Italic amphorae in the Mediterranean in the Hellenistic and Roman period.

It also attests the will to deepen the knowledge of key areas (**Etruria, Latium, Campania and Sicily**) for the hellenistic and Roman period. Thus most of the data concern these very areas.

Therefore, to summarise the new data bank features:

- it centres on ceramics of Italic production and production sites (4^{th} century BC – 2^{nd} century AD)
- it is being progressively broadened as very specific archaeological problems are being tackled
- it aims at the investigation of subjects of research which remain constant in different periods and geographical areas (study of the production areas, the establishment and organisation of workshops, the diffusion of wares with peculiar technological features).

P-11

DETERMINATION OF THE PROVENANCE OF VINICA TERRA COTTA ICONS USING SUPPORT VECTOR MACHINES

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Vinica terra cotta icons were found during a systematic archaeological excavations in the Vinica Fortress, Southwest of the town of Vinica, in the Eastern part of the Republic of Macedonia. They are all dated from the 6th to the 7th century and they represent exceptional examples of our Christian cultural heritage.

Detailed chemical examinations have been performed in the years after their excavation. Ten samples of partially preserved fragments of terra cotta icons and thirty three clay samples from eight different sites in the region have been analyzed using different instrumental techniques: X-ray fluorescence, atomic absorption spectrophotometry and flame photometry. The simple comparison of the obtained data was not able to determine the exact location of the clay used for the terra cotta icons.

In this work, the attempt to develop a reliable chemometric method for determination of the origin of these unique terra cotta icons based on support vector machines (SVM) is demonstrated. For this purpose, a non-linear SVM with Gaussian kernel function was used. By changing the parameters of the SVM models (the width of the Gaussian kernel function and the value of the penalty parameter), the models with the smallest number of support vectors, and at the same time, with the best generalization performances were searched.

Using the models with the best generalization abilities, it was possible to determine that the analyzed samples of the terra cotta icons found in the Vinica Fortress were produced locally by masters of the Early Christian art. Our results were also confirmed using principal component analysis and self-organising maps[1].

[1]Vinka TANEVSKA, Igor KUZMANOVSKI, Orhideja GRUPČE, (2007): Provenance determination of Vinica terra cotta icons using self-organising maps, *Ann. Chim-Rome*, 97: 541-552.

P-12

COMPARISON OF MINERALOGICAL TRANSFORMATIONS BY FIRING CALCITE AND DOLOMITE RICH CLAYS, USED AS RAW MATERIALS FOR ANCIENT CERAMIC PRODUCTION IN ALGARVE REGION, PORTUGAL

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In the Algarve basin (south Portugal) there are various roman archaeological sites where is evident the ceramic production in local kilns, which makes very interesting the study of regional clay deposits in order to establish the raw materials provenance.

Because many clay deposits from Algarve are rich in carbonates of various compositions, we think it is important to better comprehend the mineralogical transformations clearly induced by the presence of carbonate phases, when the clays are fired at the same temperature. To investigate mineralogical transformations we choose two naturally occurring clays extremely enriched in carbonates (calcite and dolomite rich clays) but relatively poor in silica. These clays were characterized in the mineralogical and chemically point of view with X-ray diffraction, X-ray fluorescence and instrumental neutron activation analysis.

Circular probes (4 cm diameter / 0.3 cm height) formed by pressed powder clay samples were fired in an electrical kiln at 9 different temperatures (300, 400, 500, 600, 700, 800, 900, 1000 and 1100ºC) in an oxidizing atmosphere. The firing cycle was 5ºC/minute and the residence time at the maximum temperature was 30 minutes.

The mineralogical transformations caused by progressive heating were investigated with X-ray diffraction (XRD) and scanning electron microscopy (SEM) with energy dispersive X-ray spectroscopy (EDS) associated, permitting X-ray microanalysis.

Since the sintering process occurs in relatively short periods of heating, it was created an environment dominated by metastable melting and rapid mineral reaction rates driven by significant temperature overstepping the equilibrium conditions. These high temperature experiments at atmospheric pressure resulted in the formation of a large variety of high temperature minerals, many of which are metastable and only found in these conditions. New phase formations were essentially dependent on chemical composition, mainly CaO and MgO abundances. In the calcite rich clay (high $CaCO_3$%) the next association of calcium silicate minerals was formed: gehlenite + wollastonite + larnite; and in the dolomite rich clay (high MgO%) various calcium-magnesium silicates (akermanite + diopside + monticellite) and other magnesium silicate and oxide minerals appeared, such as forsterite, periclase and spinel.

The XRD patterns and microanalysis are able to detect a potassium-calcium sulfate phase, developed in both samples, at temperatures between 900ºC and 1100ºC.

P-13

NON DESTRUCTIVE ANALYSIS OF A RED FIGURE VASE OF UNCERTAIN ATTRIBUTION FROM FALERII VETERES

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The subject of this research was a red figure calyx krater of excellent workmanship found in the Celle necropolis in Falerii Veteres and kept in the Museo Nazionale Etrusco di Villa Giulia in Rome. Since its discovery, at the end of the XIXth century, the vase has been the subject of a great archaeological dispute and it has been attributed, from time to time, to Faliscan, Campanian, Southern Italian or Greek production. Recently, some archaeologists advanced the hypothesis that it could be a work of the Athenian potter known as the Uppsala painter.

In order to try to settle this dispute the elemental composition of the ceramic and of the painted surface of the vase, determined by X-ray fluorescence (XRF) spectrometry, was compared to that of other red figure vases coming from different workshops and kept in the Museo Nazionale Etrusco di Villa Giulia in Rome and in the Museo Archeologico dell'Agro Falisco in Civita Castellana. The vases were analysed in situ using a portable XRF spectrometer operating in air and constituted by an X-ray generator with a Pd anode, a Peltier cooled Si-pin X-ray detector and an electronic chain for the amplification and the detection of the signal. The comparison of the relative percentage of the minority elements, in particular Cr, Ni, Sr, Rb and Zr, lead to exclude any similarity between the vase and the ones of Italic production while the presence of Ni and Cr with a relative percentage comparable with one measured in all the Greek vases could support the archaeological attributions to an Athenian workshop.

P-14

BYZANTINE KILNS OF SOUTHERN ITALY: AN ARCHAEOMETRIC LOOK

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The early medieval (7^{th}-9^{th} century AD) production of the Byzantine kiln of "Cantiere Mitello" by Otranto, an harbour on the Apulian Adriatic sea, has been investigated through SANS and TOF-ND measurements. In this site different groups of artefacts can be recognized: transport amphorae of different size and a series of tableware such as pots, saucepans, basins, lids and small pitchers used in domestic life.

By correlating the results of the diffraction and SANS experiments, we can make inferences on the evolution of the firing technique used in that site during the Early Middle Age, and make a comparison with previous results for similar handmade articles found in Miseno and Cuma on the Tyrrhenian sea. Otranto and Miseno or Cuma are in the east or west coast of Italy respectively, thus implying different end-market of the products.

As far as the samples of Otranto are concerned, a principal component analysis (PCA) of the mineralogical phases shows that all the groups are very close to each other, although they keep their centroids separated. In particular the tableware group is quite distinct in respect to the others, although there is a partial overlap with a specific group of small amphorae. A similar grouping scheme is present in the SANS data, which are more sensible to the maximum firing temperature.

The combined use of both techniques leads to the conclusion that tableware was fired at a temperature a bit lower than the other objects, and very likely in a reducing atmosphere, as suggested by the presence of the magnetite.

P-15

EXPERIMENTAL ARCHEOLOGY: BRONZE AGE POTTERY PRODUCTION IN *TERRAMARE* (NORTHERN ITALY)

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During the Middle and Late Bronze age the Po Valley (Northern Italy) settlements were fortified villages called *terramare*. The *terramara* of Montale (Modena) has been recently excavated and is now an archaeological park with many experimental activities (www.parcomontale.it).

The pottery of Montale and other sites of the same area has been classified in 11 phases (1600-1250 BC) and investigated with archaeometrical and technological analyses (PE, XRD, XRF, radiographies) in order to define the raw materials and the manufacturing techniques.

According the analytical results a new series of experiments has been conduced in the park of Montale, with a professional potter, to test the similarity between the composition and the technology of ancient pottery with the experimental reproductions.

Different shapes (bowls, cups, jars, pithoi) for each phase have been reproduced using the most compatible local clay, tempered with grog, the pots have been manufactured by traditional techniques (coils and moulds), and the firing has been performed in a kiln that is reconstruction of a bronze age kiln.

All the production phases have been recorded and described focusing on tools, time and difficulty (technical and “artistic”).

The results help to define the manufacturing process of the different shapes (and decorations) in the various phases, and contribute to the discussion of craft specialization.

P-16

CHARACTERIZATION OF ANCIENT CERAMICS BY PHYSICAL – CHEMICAL ANALYSIS

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For the study of ceramics, dating from the Ist and the IInd century B.C., discovered during the archaeological excavations at Dumbrava–Iaşi, Romania, polarized microscopic analysis was carried out in an attempt to identify the clay compounds and the non-plastic inclusions. To complete the data obtained through petrographic analysis, we also used X-rays diffraction.

The analyses focused on eight samples (no.1-8). According to the data obtained using the petrographic analyses, they were grouped as following: 1-5; 2-3; 4-6-7-8. The differences in compositions among the samples are minor and accidental. In the samples there are minerals such as mica, feldspars and some others minerals specific to these sorts of clays, and quartz, which predominant presence makes us think that sand was the main tempering material used.

With regards to the work procedure, the parallel orientation of the inclusions shown in thin sections indicates that the ceramics were made by using a wheel.

Concerning the combustion temperature only an approximate judgment can be made. Taking into account the glassy aspect of the paste and the presence of some minerals that decompose or become amorphous over a certain temperature such as calcite, sericite, orthoclase, etc., we can conclude that the combustion temperature varied between 600ºC and 750ºC. The hematite, found in most of the samples indicates the presence of an oxidant medium.

The same samples were submitted for X-ray diffraction analyses. The comparative study of X-ray diffraction patterns of the samples points out a similar composition of the eight samples. The minerals identified by X-ray diffraction, present in different proportions in these samples, are the following: quartz, biotite, potash mica, sericite, orthoclase, oligoclase, albite, hematite and calcite.

Taking into account the aspects of X-ray diffraction patterns the samples were grouped as following: 1-3-4; 5-6-7-8; 2.

P-17

A POST 79 A.D. COMMON WARE PRODUCTION FROM POMPEII (ITALY)

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Via Lepanto site is one of the best examples showing how the *Pompeii* region was partially reconstructed, and re-occupied early, after the Vesuvius eruption of 79 A.D. This rural site was occupied from the first half of the 2nd until the 5th century A.D. The intense volcanism between the late 5th and the early 6th century A.D. could have caused a dramatic change in the settling patterns of this region, although literary sources indicate that this did not provoke any radical breaking off with the previous landscape.

The large amount of ceramic findings displayed the typology in use in this area between the 4th and 5th century A.D.; most of the *amphorae* found in recent excavations came from North Africa, Spain and Eastern countries; the fine ware of local productions was an imitation of African ceramics; analyses were focused on two common ware ceramic productions: a table ware (28 samples) and a cooking ware production (23 samples); archaeometrical data were obtained using chemical and minero-petrographical methods (OM, XRD, XRF and SEM).

The common ware production was represented by the sherds of food and storage vessels including the *Steccata*, *Dipinta* and the so-called *Pseudo-Sigillata* wares, the latter shows typological characteristics that retain the stylistic pattern (shape and colour) of more ancient and valuable *Terra Sigillata* ware. Cooking ware production included shards of lids, pots and saucepans. All the samples were manufactured using a non-calcareous clay (each table and cooking ware) with different proportions of volcanic temper in function of its domestic use; the only exception was represented by the *Dipinta* ware, characterized by a calcareous paste and no temper addition. Volcanic temper was constituted by calcic clinopyroxene (diopside and salite), potassic feldspar (sanidine), pumices, scoriae; the latter sometimes showed leucititic modal composition.

Only one sample of cooking ware contained exotic volcanics in the clay matrix, constituted by large crystals of quartz, anorthoclase and sodic clinopyroxene (aegirinae); this sample belongs to the well-known *Pantellerian Ware* ceramic class, found and studied by the authors in other Late Roman sites of the Campanian area.

Firing temperatures were estimated using either mineralogical or micro-textural methods; as far as illite-bearing samples are considered, a low stage of vitrification allowed to hypothesize a firing temperature of about 850°C. The occurrence of secondary diopside along with a continuous vitrification of the clay matrix (also showing small rounded pores) indicated higher firing temperatures (900°C).

Reference groups for all ceramic production can be attested comparing chemical data of the shards with some kiln refuses from a Pompeian Roman furnace using bi- and multivariate data treatment.

P-18

POST-DEPOSITIONAL FORMATION OF MACRO-PORES AND SECONDARY FILLING IN NEOLITHIC POTTERY

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Archaeometric studies of pottery recovered from archaeological excavations in the Neolithic site of Sammardenchia (Udine, Italy) have shown a great number of macropores in all the shards, in form of cavities, 0.2 to 1.5 mm in size, with sharp boundaries and quite regular shapes. The results of chemical analysis of the pastes put into evidence the presence of exceptional quantity of phosphorous, in some cases around 9% P_2O_5, and pretty high iron contents (about 7-9% Fe_2O_3).

Firstly, it was hypothesised that the voids were of primary origin, pursued by the ancient potter in order to obtain very light objects. This macroporosity could have been obtained by introducing seeds or crushed straw, which completely burnt out during the ceramic firing. But this hypothesis is to be rejected because both the shape of the cavities and the absence of reaction borders do not support it. Also the idea of carbonate inclusions decomposed during firing cannot be valid, due to the low calcium content of the ceramic paste (less than 1.5% CaO) and its deduced firing temperature (650-700°C), below that of carbonate decomposition.

So, it is necessary to think to a secondary origin of these voids, due to the corrosion of the original grains during burial. Carbonate grains or crushed bones could be hypothesised, introduced in order to improve the thermal stress resistance. The use of crushed bones is supported by the phosphorous data, but it is scarcely compatible with the low calcium content in the paste and the regular shape of the cavities. The original presence of carbonate grains is compatible with the low firing temperature of the ceramic objects, the sharp boundaries and the regular shape of the cavities. If it assumed that calcite was completely decomposed during burial in an acid environment. The soil acidity is demonstrated by the recovery of only rare and corroded remains of bones. Of course, it has to be assumed that calcium from calcite and bones was completely removed by soil solutions.

P-19

PREHISTORIC CULTURES OF SONQOR PLAIN

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In an archaeological view, Kermanshah Province is one of the most important cultural domains in Iran that is known up to now. It has a great effect on the history and culture of Zagros mountain and the west of Iran. Total human life's periods and stages have been passed in this region from Paleolithic to the pre-historic period, historic period and Islamic period. The following obtained remains prove our statement. Caves such as: Shekarchian (Carlton S.Coon,1949), Khar (Carlton S.Coon,1951), Warwasi rock shelter (Bruce Howe,1960), ancient settlements such as: Gakia(Smith), Sarab (Louis D.Levine,1974), Ganj Dareh (Smith,1968), Asiab (Braidwood,1961),Seh Gabi (Louis D.Levine,1974), Godin (Cayler T.Young,1969), Chogha Gawaneh (Abdi,1999) and etc.

This region had an important role in expanding the trade between Mesopotamia's people with poor resources and Iran plateau, mountain region and oriental region with rich resources (Hole,1987). Having an appropriate climate and natural and economical geography lead it to enter food production period. Different anthropological and archaeological schools considered it as an archaeological lab, and some expeditions such as Robert Braidwood's "The Iranian prehistoric project,1959-61" and Louis D. Levine's " The Neolithic and Chalcolithic periods in Mahidasht, 1975" studied this region.

In spite of several archaeological investigations and regular surveys in central Zagros and Kermanshah province and after a century of these activities, a few areas of this cultural territory are unidentified up to now. One of them is Sonqor with an area of about 2320 square kilometers. The lack of regular archaeological investigations lead us to pay less attention to the appearance of the first groups, the quality of primeval settlement in the plain, the history of groups and social evolution, regional and trans-regional communication and trade, political, social and economical structures.

In spite of this fact, many excellent evidence and documents are collected by our preliminary survey that are explained and commented in terms of their arrangement in prehistoric periods.

These documents show that this region has many prehistoric settlements such as Tepe Khodaei, Tepe Sheikh Jalil, Tepe Ab Naz, Tepe KalGah Zaman, Tepe Ali Baig, Tepe Gabristan and etc. These ancient settlements have a great importance on the development of cultural and social organizations in Kermanshah region.

To have a comment on gathering data from two season surveys in Sonqor as a first step this article introduces prehistoric periods and their cessation and permanence, and as the next step it discusses prehistoric settlement models of this region.

P-20

IN THE LIGHT OF CERAMIC EVIDENCE THE END OF KURA-ARAXES CULTURAL COMPLEX IN THE ERZURUM REGION

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The Early Bronze Age culture of Eastern Anatolia, namely Kura-Araxes Culture, Karaz Culture or Early Trans-Caucasian Culture had existed in a huge area which extends from the Caucasian Range to the Philistine. The culture lasted for almost two thousands years from the mid. 4th to the mid. 2nd millennium BC, and this long-termed endurance created several chronologically and geographically chronic problems in the understanding of the structure of the mentioned culture. These problems show differences from its denomination to its chronology. Because of the greatness of chronological and geographical distribution of this culture it is determined as "a cultural complex" by most archaeologists. According to most, these chronical problems can be solved by increasing local investigations. In the light of this approach, in this paper I want to discuss the results of the project, which was performed in recent years in the Erzurum Region. The most important stage of this project is the reconsideration of the earliest excavations in the Erzurum region in the light of the results of the new investigations in this area (etc. Sos Höyük excavations).

As known, the Erzurum Region, especially with Karaz, Pulur and Güzelova mounds, has a special place within the spectrum of this culture. The assemblage provided by the earlier researches has been improved by the recent ones, and a clearer consideration about the region is much more possible today. The ceramic evidence from these three sites presents data about this culture from the earliest to the final stage. The stages of cultural developments of the Kura-Araxes can be traced when the ceramic evidence from the key sites of the Erzurum region is considered. Especially the ceramic assemblages from Pulur and Güzelova can submit interesting clues related to the end of this cultural complex in this area. The main aim of this paper is to take the entire data, involving this case, collectively in hand, and introduce a construction for the end of this cultural complex at least for the Erzurum Region.

P-21

'FEATS OF CLAY FROM AEGINA'

A DIACHRONIC INVESTIGATION OF A MAJOR POTTING CENTRE IN THE AEGEAN

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The island of Aegina, situated in a nodal location and bearing extensive deposits of Neogene clay beds and more recent volcanic lavas, has been one of the major potting centres in the Aegean during certain prehistoric and historical periods. Kolonna, the main settlement known on the island, thrived for most of the Bronze Age (2nd millennium BC). Potter's kilns recovered at the site and the wide distribution of Aeginetan vessels across the central Aegean region indicate the significant role of Aegina as a producer and probably distributor of ceramic products. The range of imports identified further signify the island's important role in regional exchange networks. This situation is not restricted to the Bronze Age. During the Archaic and Classical periods (mainly 6th-5th c. BC), ample archaeological evidence testify to the island's prosperity and political role. Aeginetan vessels of that period, mainly cooking pots, reach many sites in central Aegean and beyond, as far as the coast of north Africa, while imported vessels from all known potting centres of the Aegean were consumed at Kolonna. Furthermore, in Modern times, Aegina has been renowned for its water jars that were desired by most traditional Greek households.

In the diachronic investigation of such an important potting centre, its changing role and the radius of its influence, cultural and environmental dynamics need to be considered together. In this context, the aim of the present project has been 1) to characterise Aeginetan ceramic products and their variation, establishing criteria for their identification, 2) to investigate potential raw material sources on Aegina, 3) to reconstruct technological choices of ancient potters and understand differences in fabrics, within and among different periods, shedding light on the island's technological traditions in different socio-economic and historical contexts, and 4) to determine the range of imported fabrics on Aegina and compare it with data from other sites in the region to provide a better understanding of the role of Aegina as a recipient and consumer of pottery.

These are achieved through an integrated study involving visual typological and technological examination, petrographic and chemical analysis of pottery from the different periods represented at Kolonna. Such a study of ancient ceramics has been combined with comparative analysis and experimentation of potential raw materials on the island and the investigation of technological choices made by modern traditional potters on Aegina.

P-22

TEXTILE IMPRINTS ON THE VESSELS OF D'YAKOVO CULTURE FROM THE EARLY IRON AGE: CULTURAL TRADITIONS OF POTTERY MAKING

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The presentation is devoted to D'yakovo culture ceramics and especially to the elaboration and regulation of the rules of textile imprints description. The author tries to find the connections between various textile imprints and technological modes of its making. The peculiarities of the position of textile imprints on various parts of vessels are also investigated. Besides, the presentation gives attention to the components of textile imprints, their direction, density and to their superposition one over the others on the surface of the vessels.

Beating and rolling with special paddles were used widely to the treatment of vessel's surfaces. The paddles were frequently covered with various kinds of braided materials or threads. It is established that the paddling and rolling of surfaces were not aimed at treating the surface only, but were applied to produce vessels of certain appearance, that is, combined two functions – technological ad decorative ones. It is proved by special disposition and zonality of textile imprints. All these peculiarities reflect various cultural traditions of D'yakovo potters.

The investigation of textile imprints on the surface of D'yakovo vessels makes it clear that such imprints had not appeared during the construction of clay vessels, but at the stage of its final treatment and decoration.

P-23

THE FAIENCE MANUFACTURE *LE BOIS D'EPENSE* (NORTH-EASTERN FRANCE, 18/19TH CENTURY)

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The french factory *Le Bois d'Epense* was an important tin-glaze pottery production site in the years 1735-1742 and 1764-1848, with almost 200 workers at the top of its activity. We present the analytical results for 56 faiences (= tin-opacified lead glazed earthenware), 28 samples of technical ceramic (saggars and spacers) and 6 local clays. Analytical techniques were optical microscopy, X-ray fluorescence (XRF), X-ray diffraction (XRD) and scanning electron microscopy, coupled to an energy-dispersive X-ray spectrometer (EDS).

As shown by XRF analysis, the faience is very homogeneous and has a typical calcareous faience body (16-24 wt.% CaO). No chemical difference can be evidenced between the biscuits and the faiences with a "grand feu" or an enamel decoration. The products from this site can easily be distinguished from the actually known french faience reference groups. The spacers were made from the same paste as the faience, but the saggars with an imported refractory clay, rich in Al_2O_3. For the faience body, a mixing of two local clays has been reported in a paper from 1877. However, the prospected local Creataceous (Middle Albian) clays never exceed 12 wt.% CaO. An addition of a CaO-rich material is undoubtly necessary to reach the 16-24 wt.% CaO of the faience. This is not a local marl, but most probably a very pure chalk from the Champagne. Firing temperatures were inferred by XRD and lie < 950°C for the biscuits and between 950-1050°C for the glazed pieces, indicating a two chambered kiln. The quality of the tin glaze is in general good, showing rare rounded quartz crystals, very few newly crystallized phases (K-feldspars, cristobalite?) and bubbles. Contrasting, the cassiterite crystals are inhomogeneously dispersed, forming clusters. The absence of any glaze-body interface is consistent with the application of the liquid glaze to an already fired body. Area measurements show that all tin opacified glazes can be classified as SiO_2-PbO glazes (~ 80 wt.%) containing about 9 wt. % SnO_2, with other oxides in concentrations < 5 wt.% . Spot analyses of the glass matrix indicate a much lower tin oxide amount of about 2 wt.% as compared to the area measurements.

P-24

ROMAN THIN-WALLED WARE FROM ERCOLANO: AN ARCHAEOMETRICAL INVESTIGATION

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Samples of Roman thin-walled ware from Ercolano were studied by Optical Microscopy (OM) and Scanning Electron Microscopy (SEM) with Energy Dispersive Spectrometry (EDS) with the aim of validating the archaeological hypothesis of local production. Thin-walled ceramic forms a widespread class in Roman Mediterranean area between 2nd century BC and 3rd century AD. Traditionally, production centres are hypothesized on the base of quantity and homogeneity of recovered material in the different archaeological sites, or on the comparison with other objects of certain provenance. The production indicators are few and, up to now, this class of Roman fine tableware has only occasionally been evaluated archaeometrically. In the Vesuvian area a production centre of these ceramics has been supposed on the base of macroscopic observations and morphologic peculiarities of the pastes. An archaeometrical investigation we have carried out on samples, classified by the archaeologists as campanian production, with the aim of, on the basis of unambiguous elements, validating or excluding the hypothesis of Vesuvian production.

Morpho-mineralogical analysis showed that all fragments are characterized by fine texture paste with a large degree of sintering and by the presence of pyroxenes, feldspars, volcanic rocks and opaque minerals - made up mainly by Mg, Si and Fe as tempering materials. On most samples an engobe layer was applied by using the same clay utilized for the ceramic body, refined and applied on vessels after drying.

Concerning the coloured surface areas, in some samples an evident morphological and compositional continuity between the red or black coloured surface and the bulk was found, that allows us to exclude an intentional addition of pigments. In other samples, however, a distinct layer with an average thickness of about 20 μm on the ceramic body was revealed. This layer shows a very compact structure with no voids and a large degree of sintering, with no clay structure evident. ED spectra revealed larger quantities of Al, Fe, K and lower quantities of Si and Ca, with respect to the ceramic body, with different Al/Si and Al/Fe ratios for red and black coloured areas respectively. These data clearly indicate that a finer - and very probably different - clay was used in the production of the black and red layers than for the ceramic body. Moreover, there is a probability that wood ash, illite and K-feldspars were added to lower the temperature at which sintering takes place and to improve the sintering properties of clay.

P-25

ALTERNATIVES FOR RECONSTRUCTING EARLY MEDIEVAL POTTERY WORKSHOP ACTIVITY (BASED ON THE ANALYSIS OF 9TH CENTURY FINDS FROM ZALAVÁR, HUNGARY)

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In 2004 a project was established in order to reconstruct the production sequence (clay preparation, forming and firing) of the 9th century AD pottery discovered on the site Zalavár-Vársziget Emlékmű. The objective was to carry out a complex interdisciplinary research on the ceramics from Zalavár, using the means of „traditional" typo-chronological archaeology, archaeometrical analysis and experimental archaeology.

As a result of research two major pottery types can be distinguished: fine, polished tableware (group A) and coarse utilitarian pottery (group B). The investigations revealed a large technological gap between the two types, thus two different production sequences and structures of workshop activity should be assumed.

Group A is characterised by a fairly good quality. The most typical form is the bottle, though mugs, glasses and lids also occur. They constitute 3% of the whole ceramic assembly. Petrological examination shows that the majority of the examined samples have serial fabric, unimodal grains size distribution and contain moderately or well sorted non-plastic inclusions. These facts suggest that these vessels were not tempered deliberately by the potter(s). Cathodoluminescence examinations revealed that both calcite and dolomite are present. Firing temperatures range between 650-850°C. The vessels had a uniform colour: a reddish-yellowish outer surface which covers a light grey core. This supposes a precise control of firing factors, and possibly the use of a two chambered pottery kiln.

In Group B the majority of finds are cooking pots of various sizes. The quality of ceramics varies from thin walled, well-turned pots containing only fine sand to thick walled, roughly formed vessels heavily tempered with coarse additives. In these cases the hiatal fabric and granulometry suggest a tempering. According to petrography, cathodoluminescence spectroscopy and x-ray powder diffraction analyses the tempering material was either a dolomitic sand, or a crushed crystalline limestone. One group of samples differs greatly: these sherds do not contain carbonatious material, but polycrystalline quartz and sandstone. This might suggest a different raw material source. The coarse pottery was poorly fired (below 650°C) in neutral atmosphere. Their surface is spotted, varying from dark greyish-brown and reddish-brown to yellowish grey.

P-26

A PRELIMINARY APPROACH FROM MATERIAL SCIENCE TO COPPER AGE FUNERARY POTTERY IN SOUTHERN IBERIA: THE PALACIO III (SEVILLA, SPAIN) *THOLOS* TOMB

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As a bibliographic study (Cordero Ruiz et al., 2006) has recently shown, Copper Age (*c.* 3200-2100 cal BC) and Early Bronze Age (*c.* 2100-1550 cal BC) southern Iberian funerary pottery is rather poorly understood. To date, only one ceramic assemblage, from the Bronze Age necropolis of La Traviesa (Sevilla, Spain) has been studied from an archaeometric point of view (Polvorinos, 1998; García Sanjuán et al., 2005). As part of a wider research project on Copper Age pottery technology, production and consumption in Southwest Spain, is actually under development (Odriozola & Hurtado 2007, Odriozola & Martínez-Blanes, 2007), which involves an active international collaboration research project between Portugal and Spain (GRICES-CSIC) (Dias et al, 2005 a; Dias et al, 2005 b; Dias et al, in press a; Dias et al, in press b). This paper proposes a material science-based study of a large funerary pottery assemblage. This study includes 50 vessels from the Palacio III (Sevilla, Spain) *tholos* tomb, a megalithic monument that was part of a larger prehistoric funerary complex including a passage grave and an Iron Age cremation (García Sanjuán & Wheatley, 2006). The methodology involved includes physical and chemical characterization techniques (XRF and XRD), statistically evaluated (cluster and discriminant analyses) in order to determine compositional groups and categorize production as well as ritual and votive patterns. We explore the technical choices along the *Chaîne Opératoire* of these vessels, their compositional grouping and the way these categories correlate with the spatial and chronological variations recorded in the use of this megalithic burial.

The record of time within the archaeological practice is constraint to the study of the recorded stratigraphic units during excavation, but funerary monuments as Palacio III passage grave may have been used along time and the funerary assemblages recovered may have been also moved from its original position along the pass of time by the different generation that have used and maintain it, and therefore the study of technological choices is constraint to spatial distribution and ritual and votive patterns exclusively. As apart of this material science oriented work we developed Luminescence dating (Zink *et al*., forthcoming, Cardoso et al, in press; Richter et al, 2003) of the vessels in order to correlate the observed technological categories, spatial distribution, and ritual and votive patterns along time with independence of the possible interferences that can result from the use of this passage grave along time.

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P-27

THE TWO SIDES OF THE GUADIANA: INLAYED POTTERY FROM 3RD MILLENNIUM BC ALONGSIDE THE GUADIANA RIVER (SPAIN AND PORTUGAL)

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Traditionally little attention has been paid to the decorating inlays of the 3rd millennium BC vessel (Bell Beakers within many other varieties of decorative motifs and themes are inlayed). Recently these inlays have awaken scholars interest as the result of new discoveries and methodologies applied to their study, which includes the proposals of production models and the estimation of firing temperatures of the vessels based on the physico-chemical transformations of the inlayed material (Odriozola and Hurtado, 2007; Odriozola and Martínez-Blanes, 2007).

Pottery inlays can be made of several raw materials –*i.e.* bone, calcium carbonates (limestone, shells), kaolinite, etc.-, but till nowadays the distribution of this *fashioning techniques* are restricted to differentiated geographical areas in Iberia, whereas calcium carbonate is distributed in the Meseta Central, Meseta Norte, and Guadalquivir Valley, and bone in the Spanish Guadiana River Middle Basin.

Along the Iberian Cooper Age period several social or settlement networks have been proposed -*ie.* Perdigões, Reguengos de Monsaraz, Portugal (Valera, 2006) or Tierra de Barros, Badajoz, Spain (Hurtado, 1995, 1999). Our goal will be to determine the technological relationships between them based on the study of pottery inlays, as apart of a larger research project (GRICES-CSIC a collaborative research framework between Spain (CSIC) and Portugal (GRICES)) that focuses on technological production and consumption in both sides of the Middle Guadiana Basin that is actually under development.

In this paper we study the technological choices referred to inlay processes by physico-chemical analysis (micro-XRF, XRD, and FTIR) in order to explore collective technical identity patterns alongside the Guadiana River -*i.e.* raw material selection and firing modes-, comparing the production technology chosen by these two geographically constraint neighbouring settlement networks of Perdigões and Tierra de Barros (Our case study Perdigões and Tierra de Barros neighbouring settlement networks are facing opposite each other separated by the Guadiana River). As a result of the study of technical identity we can engage the result of these fashioning techniques with social boundaries within the archaeologies of landscapes.

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P-28

NEOLITHIC POTTERY TRADITIONS OF ÇATALHÖYÜK, SUBERDE AND ERBABA (CENTRAL ANATOLIA): BASED ON TRADITIONAL AND ARCHAEOMETRIC ANALYSES

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In this research I studied the pottery assemblages of Çatalhöyük that has an uninterrupted and reliable cultural sequence and is a key settlement not only in respect of understanding the development of all of the pottery sequences of Central Anatolian Neolithic, but also for the whole Anatolian Neolithic, and Suberde and Erbaba in Central Anatolia.

I examined the materials which were not studied on before in terms of traditional visual and archaeometrical analyses seeking for ceramic technology eg. clay sources, tempers, firing and manufacturing technology, surface treatments, which all constitute ware groups, vessel forms and typology. In addition to these I discussed the production properties of the assemblage with some local potters and ceramic artists.

In the Neolithic pottery assemblage of Çatalhöyük, I distinguished three kinds of traditions and defined them: "Early, Middle and Late Traditions" as a new approach. When I studied the material from Suberde and Erbaba, I realized some very similar characteristics in production properties among three sites in the Konya Basin.

One of the aspects of this research could be considered as a methodological development in pottery studies, by forming a "Typology of Common Pottery Traditions" from different pottery assemblages.

What does "tradition" mean and how it was determined? Searching and comparing the material with traditional and archaeometrical analyses and considering similarities and differences, the traditions were defined from a more general point of view. As well as this inductive approach which were constructed based on production technology; interaction of cultures and dating of the pottery are the other aspects of this paper.

On the other hand, the earliest ceramic examples of Anatolia and The Near East will be presented here in some distinctive horizons.

P-29

ANALYSES OF ROMAN POTTERY AND LAMPS FROM AQUINCUM AND INTERCISA

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Roman *Firmalampen* from Aquincum and Intercisa have been analysed by WD-XRF to distinguish imports from local products. The series included 33 lamps and 48 samples of moulds and various pottery. Reference groups are available from the lamp making centres in Modena, Poetovio and Carnuntum which could be the source for imports in Aquincum. For a reference group of Aquincum made pottery several moulds for *Firmalampen* were sampled as well as pottery finds from kiln sites, including two pottery wasters and a clay sample. In Intercisa 17 *Firmalampen* and 3 moulds and 2 bricks were analysed. The interpretation of the data yielded surprising results: one mould from *Firmalampen* turned out to be non-local and two moulds for *terra sigillata* did not belong to the local pottery group but were similar to some of the analysed *Firmalampen* both from Aquincum and from Intercisa. On the other hand, only a few lamps in Intercisa were attributed to the Aquincum group, the greater part of them, including all lamps stamped by VICTOR, forms a probable local group. The previous macroscopic attributions in many cases turned out to be wrong, even though they were based on stamped names.

P-30

PROVENANCE STUDIES ON TROJAN LATE BRONZE AGE FINE WARES FROM TROY AND IT'S NEIGHBOURHOOD USING NEUTRON ACTIVATION ANALYSIS (NAA)

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Anatolian Grey Ware (AGW) and Tan Ware (TW) are the characteristic fine wares of LBA Troy. In Troy AGW already appears at the end of the MBA, in Troy VI Early (approx. 1750 - 1590 BC) with new forms, which possess strong similarities to Greek shapes of the stage MH II. At this time the quantity of Grey Ware in the spectrum of Trojan fine ceramics amounts to only 10%, however, it is very important for chronological classification. In the course of Troy VI Early these Greek shapes disappear slowly and Anatolian characteristics in pottery increase. In this early phase AGW contains very much mica, which gives a shining coat to the vessels, so that a comparison to metal containers forces itself upon the researcher. Due to the mica it is called as "mica - rich Anatolian Grey Ware" and/or "Early Anatolian Grey Ware" (AGWEarly). In Troy VI Middle (approx. 1590 - 1430 BC) appears a new, lightbrown, tan pottery called Tan Ware. Nearly simultaneously a Mycenaean style painted pottery as well as imitations of Mycenaean shapes in local fine wares (in AGW and TW) also appear for the first time. Tan Ware reaches its climax in Troy VIIa (approx. 1300 - 1190/80 BC). The so called "brown burnished Ware" (W721) also appears at this time. It has got the same characteristics as Tan Ware but is additionaly covered with a brown coat. [2] For a long time Tan Ware was always regarded as the counterpart to Anatolian Grey Ware fired in oxidizing conditions. In 2006 the analysis of 45 samples of AGWEarly, AGW, TW and W721 from Troy confirmed this. So a basis for further investigation could be created. In Summer 2006 further samples from Troy and from some sites in the Troad were taken. Furthermore, samples of imported pottery from the islands off the coast of the Troad (e.g. from Samothrace) were taken, too. This allows to better recognize the contacts between Troy and the islands. The results of the analysis from 2006 were compared to data of analysis at Trojan pottery already published by Knacke Loy 1994 [3] as well as to data published by Mommsen et al. 2001 [4] and 2006 [5]. The data was compared using multivariate statistics and is represented in a Dendrogramm (fig. 2).

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P-31

POTTERY TECHNOLOGY OF VINČA: PROVENANCE AND CHARACTERIZATION OF RAW MATERIALS AND EXPERIMENTAL RESEARCH

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Pottery of Late Neolithic Vinča culture of the Central Balkans is very well known. However, technology, manufacture and firing techniques are still unknown. Therefore, complex interdisciplinary investigations were conducted in order to determine microstructure, composition, porosity and other characteristics of late Vinča pottery (Vinča-Pločnik phase), as well as to identify raw materials used by Neolithic potters. The total of 13 samples of typical Late Vinča pottery sherds (bowls, amphorae, jars, pans) were selected for various analyses. Concerning the fact that raw materials are usually of local origin, geological research were also conducted in the vicinity of the archaeological site. The total of 5 samples were taken for further analyses (loess deposits, alluvial deposits from the right bank of the Danube, clayey formations of Miocene lake deposits). Two groups of test briquettes were prepared from these samples: 1. briquettes made of pure raw material and 2. composite ones. Briquettes were experimentally fired in a pit (in a reducing atmosphere) and in a laboratory electric kiln (oxidizing atmosphere). The results of XRD, AAS, chemical elemental and mineralogical analyses of archaeological pottery revealed that all vessel types were made of the same clay. Technological analyses were also conducted: water absorption, density, apparent porosity, true porosity and sintering rate. On the basis of the results of comparative analyses of pottery and fired briquettes the original raw material used by Neolithic potters was identified. In order to reconstruct pottery forming techniques experimental vessels were made (by pinching, coiling and combined mould/coiling techniques) using raw materials with different amounts of various inclusions (crushed riverine shells, animal dung, grog, rough and fine sand). Half of the dried vessels were experimentally fired in a pit (in a reducing atmosphere), and the other half in an open fire (in oxidizing atmosphere). Several vessels from the open fire were subjected to post firing reducing treatment. The main goal of the experiment was the definition of performance characteristics of the raw materials mixed with various types of inclusion during the whole pottery manufacture process.

P-32

CHARACTERIZATION OF THE MEROVINGIAN POTTERY FROM PRODUCTIONS CENTRES IN THE MOSAN VALLEY

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In the northwest of Europe, at the roots of the Middle Age, was the Merovingian period, which remains almost unknown because of the lack of explicit textual evidence. Hopefully, various archaeological documents provide a corpus of rich subjects to study. Thanks to the ceramic of this period, some information can be collected to reconstruct the economical, social and cultural history.

Along the Mosan valley region that would become important with the Carolingian dynasty, some cities took in many craftman's activities. In two of them, Maastricht and Huy, potter's kilns have been found and excavated but, up until now, there are still many aspects unknown about the manufacturing techniques of the Merovingian pottery.

The aim of the present study is to distinguish and characterize the productions from the two centres, Huy and Maastricht, concerning the manufacturing techniques and clay used by the Merovingians potters. This would then allow to redraw the distribution of this pottery in the Mosan valley at the beginning of the Middle Age.

In this view, besides the archaeological approach, Mosan pottery was analyzed by the means of different analytical techniques. Representative samples of productions were chosen to make thin sections for petrographic observations in order to obtain information about mineralogical characteristics. The same samples were then analysed by PIXE to define their chemical composition.

P-33

NEOLITHIC POTTERY FROM ALBA IULIA – "LUMEA NOUA" AND LIMBA ARCHAEOLOGICAL SITES IN TRANSYLVANIA (ROMANIA): COMPOSITION AND TECHNOLOGICAL ASPECTS

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Contrary to other European regions, there are still many unknown aspects about the origin and production techniques of prehistoric pottery discovered in the Romanian territory.

The present study is a part of a systematic archaeometric investigation on the Neolithic artefacts discovered at Alba Iulia - *Lumea Noua* and *Limba* archaeological sites in Transylvania (Romania).

The research focuses on the characterization of the pottery fragments belonging to Lumea Noua and Vinča cultures in order to achieve information about the provenance and manufacturing technique used for their production. A multianalytical approach was adopted; chemical, mineralogical, microstructural and petrographic features of the ceramic bodies were determined by X-ray fluorescence (XRF), X-ray diffraction (XRD) and optical microscopy. Chemical composition of the slips and painting materials was identified by SEM-EDS analysis.

The petrographic examination of the thin-sections allowed the individuation of two different types of pastes, the primary distinction being related to the presence or absence of various types of bioclasts.

Textural features, observed through optical microscope and the results of XRD analyses suggested that the firing temperatures for the studied potsherds fall in the interval of 600–900°C.

On the basis of the results of the archaeometric investigations it was possible to "reconstruct" the stages used for production of ancient pottery.

P-34

POTTERY AND PIGMENTS FROM THE I.E. EXCAVATIONS IN THE FORUM OF POMPEI

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Over the last few years, the University of Venice has been involved in the study of the finds retrieved by 1980/1981 stratigraphic excavations carried out in the eastern side of the forum of Pompei (so called i.e. excavations). While study of the bulk of the ceramic material is still in progress, an interesting group of complete vessels, still containing abundant quantity of different pigments, has been the object of interdisciplinary research. A typo-chronological approach to the study of these ceramic containers has been combined with chemical analysis and scientific characterization of their fabric and content.

In addition a comparison has been made between the identified pigments and the analyzed traces of ancient colourings found on some ceramic objects (from the same excavation area) such as terracotta figurines, moulded tiles and architectonic decorative elements. The final aim was to understand to what purpose the pigments were used and why they were kept in small ceramic vessels (in black glaze and plain coarse ware) normally used in religious rituals or as table wares. The acquired data throw interesting light on the local production of painted decorative objects and technologies employed and the results of integrated research will be fully presented and discussed within their context.

P-35

NEW INSIGHTS INTO THE SUPPLY OF WINE AND OLIVE OIL TOWARDS ROME: EVIDENCE FROM THE ÉCOLE FRANÇAISE DE ROME *CHATEAU D'EAU PROJECT* AT OSTIA ANTICA

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Two seasons of excavation (2004-2005) by the École Française de Rome and partners at Ostia Antica resulted in the recovery of about 2300 kg of Roman pottery dating primarily from the mid first to the mid second century AD. The ceramics derived from stratigraphically excavated deposits with a low percentage of residual material. In fact the majority of the deposits represent largely undisturbed refuse heaps which are allowing the current writer to investigate supply trends towards Ostia and Rome.

The study of supply trends of amphora-borne commodities and domestic pottery in Rome and Ostia is not entirely new and the most important studies emerged in the 1980s with large-scale excavations at the Terme del Nuotatore in Ostia and at the Temple of Magna Mater in Rome. In recent years more refined studies have emerged based upon materials from the Palatine Hill, the Arch of Constantine and the DAI/AAR excavations at Ostia.

Current research on the materials from the EFR Chateau d'eau Project will help to refine our knowledge of the supply of wine and olive oil toward Ostia and Rome in a number of ways. First, we have a more nuanced understanding of fabrics and are better able to distinguish regional varieties of amphorae (e.g. Umbrian or Emilan amphorae as opposed to the generic Italian amphora). Second, a number of recent authors are considering the volume of liquid contained in amphorae rather than simply the number of sherds, weight or vessel counts. Finally, recent work by this author assesses local wine and olive production in Rome's hinterland despite the absence of amphorae from this region. Since the overland transportation of these commodities was likely in wooden barrels or skins which are not detectable archaeologically, the author has worked out a formula to assess local wine and oil production that can be integrated with ceramic data, providing a more accurate vision of supply trends.

P-36

GRAECO-ITALIC AMPHORAE IN THE REGION OF OSTIA: ARCHAEOLOGY AND ARCHAEOMETRY

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Recent excavations carried out by the Soprintendenza archeologica di Ostia in the *Ager Portuensis* near Ostia brought to light a number of republican sites which are thought to be connected to the production and commercialization of salt (1). This region has played an important role in Rome's history, because of the presence of the salt marshes and its strategic position on the mouth of the Tiber.

The excavated contexts contain graeco-italic wine amphorae of types 5, 5-6 and 6 of van der Mersch's classification associated with black-slip ware and local common wares. The circulation of wine and amphorae in Northern Latium in general has not been studied yet, and these excavations provide the opportunity for an assessment of the situation in the republican period.

The archaeometric study comprises petrographical and chemical analyses (X-ray Fluorescence WDS) chosen among amphorae from various sites. The provenance determination relies on existing databases of kiln sites of Roman Amphorae (> 500 analyses, Laboratoire de céramologie de Lyon and Dept of geosciences of the University of Fribourg).

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P-37

THE SYMBOLIC MEANING OF SOME CERAMIC ITEMS OF ROUGH PASTE BELONGING TO THE THE PRECUCUTENI-CUCUTENI-ARIUŞD-TRIPOLIE ENEOLITHIC CULTURAL COMPLEX

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The pottery belonging to Precucuteni-Cucuteni-Ariuşd-Tripolie Eneolithic cultural complex generated numerous discussions in the specialized literature. Unfortunately, most of the debates refer to the painted ceramics specific to this cultural complex.

Only few researches were focused on the items made of rough paste, the so-called domestic pots, with appreciations concerning the origin of this type of ceramic ware in relation to the painted ceramics.

We mainly consider the rough paste which includes chaff in its composition and grog and/or small stones that was used to create pots of various forms and sizes, especially items of big and average size (the so-called ewers or *phytoi*) but also some containers for keeping very valuable objects of those communities.

The poster points out another perspective on some containers more or less recently uncovered, made of rough paste and whose symbolical meaning may be more or less obvious. Having as a starting point the fact that such rough paste was used to created containers of items with a clearly symbolical meaning (such as the religious compound of Isaiia, Iaşi, Romania or the hoard of jewelry items of Brad, Bacău, Romania), the poster will present a ritual meaning of the "boxes" preserving the above mentioned valuable items but also some containers used as pots for storing food (which were either decorated with anthropomorphic representations as reliefs such as the items of Scânteia - Iaşi, Bârlăleşti - Vaslui, Dumeşti – Vaslui, or had the interior painted in red and also some parts of the exterior). In this latter case, the minimal ornamentation (the painting in red of some exterior areas) did not have an aesthetic meaning, but a symbolical one, that has insufficiently been pointed out so far in the specialized literature.

P-38

FUNCTIONAL ANALYSIS OF POTTERY FROM THE EARLY NEOLITHIC SITE OF BLAGOTIN, CENTRAL SERBIA

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The site of Blagotin is situated in central Serbia, in the village of Poljna. It is a multilayer site, inhabited from the Early Neolithic (Starčevo culture) until the Early Iron Age. During the period between 1989 and 1997 an area of approximately 300 m^2 was excavated. The poster presents detailed functional analysis of Starčevo pottery excavated in the structure, marked as structure 03. Quantitative, morphological, archaeometrical and use alteration analyses were conducted on the sample of 47 whole vessels and approximately 600 rim sherds. Basic criterions for morphological analysis were openness of the vessels (restricted/unrestricted vessels), absence/presence of handles, absence/presence of necks and examination of vessel profile. Criterions for archaeometrical analysis were vessel dimensions: height, volume, rim diameter, orifice diameter, orifice constriction ratio, height/rim diameter ratio, height/shoulder diameter ratio, base diameter/shoulder diameter ratio (vessel stability) and others. Criterions for use alteration analysis were position and distribution of abrasion marks and patches, sooting clouds on the exteriors and carbon deposits on the interiors of the vessels, as well as surface pitting. The results of comparative morphological and use alteration analyses revealed that it was possible to identify major functional classes of pottery vessels (food processing and cooking, storage and serving/eating vessels) with finer divisions within each class. Within the class of cooking vessels it was possible to identify vessels used for boiling food (medium sized opened bowls of medium fabric) and vessels with carbon patterns caused by heating food in the absence of water - parching or roasting (slightly restricted bowls of finer fabric). Of particular interest is a class of food processing. Many open unrestricted bowls of medium fabric showed heavy pitting in the interiors of the vessels, caused by chemical erosion. It could be caused by fermentation of highly acidic food. Within the class for storage it was possible to determine vessels for short term and long term storage; vessels for storage of dry food, as well as vessels used for storage of liquids. Many of the investigated vessels were also multifunctional. As a conclusion, it should be emphasized that the functional analysis of pottery is very important in the reconstruction of everyday activities of the Early Neolithic society.

P-39

MINERALOGICAL AND PETROGRAPHIC ANALYSES OF TILES FROM THE LATE ROMAN NECROPOLIS OF PRIAMAR, SAVONA (LIGURIA, NW ITALY)

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The late Roman (IV-VII c. AD) necropolis on the top of the Priamar hill (Savona, the ancient *Savo*), now included in a XVI c. fortress, is composed of 87 tombs. Some African amphorae were used for children's burials, but in most cases Roman tiles (*tegulae*) were utilized ("tombe a cappuccina"). The tiles show fairly homogeneous shape and dimensions; no stamps are present.

The ceramics of the necropolis are thought to come from the abandoned *municipium* of *Vada Sabatia* (Vado Ligure), which lies a few kilometeres to the west of Savona and is still poorly investigated by archaeologist.

Optical microscopy and XRD analyses were carried out in order to obtain information about provenance and production techniques of the tiles. Local sediments and kiln wasters of various ceramic wares were used as reference materials.

Several fabrics have been recognised, randomly distributed in the necropolis and even in the tiles of the same tomb. Most fabrics can be referred to a few productions of the local area (the coastal strip between Albisola and Vado). Fe-rich alluvial clays and Pliocene fossiliferous carbonate-rich sediments were used as raw materials, sometimes (intentionally?) mixed together. Alluvial or marine sands, mostly derived by gneisses and amphibolites of the local Palaeozoic basement, were frequently added as a temper.

The abundant sandy grains, sometimes compositionally and texturally different from the temper of pastes, that can be observed on one surface of the tiles, indicate that sand was sprinkled on the bottom of the moulds in order to facilitate the separation of the raw tiles.

An interesting result is the presence of a few samples with fabrics characterised by inclusions incompatible with local rocks. In most of these cases, acid metamorphic and volcanic rock fragments are included in a fossiliferous carbonate-rich matrix. Southeastern France might be a possible provenance area for these imports. An uncommon long-distance trade (probably by sea) of tiles is also demonstrated.

P-40

THE ROMAN ARCHAEOLOGICAL SITE OF PIETRATONDA (SOUTHERN TUSCANY, ITALY): AN ARCHAEOMETRIC STUDY OF BRICKS

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Until now the archaeological excavations carried out in Pietratonda (Southern Tuscany) show a Roman site in which three different sectors can be identified: the baths, a housing and a production area. On the basis of archaeological data the building of the production area can be attributed to a more recent period than the other two sectors.

In order to characterize the bricks of all sectors several samples were collected from different ruins of the archaeological site. In particular the sampling was focused on the *opus spicatum* floor located in the housing area, on the *sospensurae* of the baths and on the drain-tiles of the channel in the production sector. Two clays different in colour (red and yellow), sampled between the bricks of the *sospensurae,* were also examined.

The specimens were investigated by means of different analytical methods, such as optical microscopy in transmitted polarised light (OM), X-ray diffractometry (XRD), X-ray fluorescence spectrometry (XRF) and differential and gravimetric thermal analyses simultaneously performed DTA-TGA.

The bricks of the *opus spicatum* floor showed a very similar composition and texture. These bricks were made with the same carbonate bearing clay. Their characteristics are different from the other bricks samples. The specimens coming from the *sospensurae* and from the channel highlighted the similarities in chemical compositions and microstructure. These bricks were made from not very different pastes. Therefore a re-use of bricks can be supposed for the channel. The firing temperatures of all the bricks can be valuated approximately between 850 and 900°C. The temper composition of the samples is in an agreement with the lithotypes present in Pietratonda area. A local provenance of the raw materials can be supposed.

The red and yellow clays showed very different chemical compositions. In fact, the CaO concentration in the red clay is about 1%, while in the yellow one is 19%. In addition their compositions are not compatible with the ones of the bricks. The bricks were not produced from these clays.

P-41

METALLURGICAL CERAMICS FROM SERIPHOS (GREECE) - TECHNOLOGICAL CHARACTERIZATION IN VIEW OF EARLY CYCLADIC METALLURGY

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Recent archaeometallurgical investigations on the Cycladic island of Seriphos have provided conclusive evidence for Early Bronze Age (EBA) copper production. Three copper slag heaps have been studied in north-western Seriphos at Kephala, Phournoi, and Avessalos. The results complement previous work on the neighbouring islands of Kythnos and Siphnos, for copper and lead-silver metallurgy respectively, and further reinforce the important role attributed to the western Cyclades as EBA Aegean metal suppliers.

The present study deals with the ceramic furnace fragments identified in large quantities on all three copper slag heaps on Seriphos. An assemblage of 54 samples, representing the three copper smelting sites, was selected for different physico-chemical examinations. Additionally, clays or clayey soils were sampled in the vicinity of each site in an effort to identify potential raw material sources, which could have been used for the furnace construction. The chemistry, mineralogy, and microstructural characteristics of the samples were studied using a combination of petrographic examination, X-ray diffraction (XRD) and scanning electron microscopy (EDS-SEM) analyses on the furnace fragments and the fired clays. Temperature gradients within the furnace walls were additionally estimated by studying the degree of vitrification by SEM and by XRD examination of individual layers taken successively from the inner to the outer surface of the fragments. The program also included luminescence dating - by Thermo Luminescence (TL) as well as by Optically Stimulated Luminescence (OSL) - of pure quartz grains extracted from furnace fragments from the hitherto undated site of Avessalos. Finally, based on the results of the study a computer model of a typical smelting furnace from Seriphos was developed, in order to assess its function and to simulate the operating conditions.

The results of this study not only contribute to the understanding of the manufacture of metallurgical ceramics on these sites, but additionally provide significant further insight into the technology of the copper smelting process.

P-42

SACRIFICING TUYÈRES.

ARCHAEOLOGICAL AND ARCHAEOMETRIC INTERPRETATION OF TECHNICAL CERAMICS IN THE FIRST IRON SMELTING (TELL HAMMEH, JORDAN; 930 CALBC) AND IRON SMITHING (TEL BETH-SHEMESH; 900 CALBC) IN THE LEVANT

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Use of iron in the Near East is first attested by sporadic occurrence of (prestige, meteoric) iron artefacts during the Bronze Age. By the end of the LBA, however, iron use increases to such a level that one can assume regular production of iron metal from terrestrial ores by smelting. Unfortunately, hardly any iron metallurgical installations are published dating before the Classical period, and very few if any of these concern iron smelting.

A major iron smelting operation was found at Tell Hammeh in Jordan (Yarmouk University; Leiden University), dating 930 CalBC. A large smithing workshop was found at Tel Beth-Shemesh, Israel (Tel Aviv University, Indiana University), dating 900 CalBC. Both were excavated by the author using especially developed techniques and feature significant quantities of various types of slag and a diversity of technical ceramics. These ceramics range from contamination of slag with molten furnace wall material through vitrified furnace wall to a large amount of tuyères.

This paper discusses the two reconstructed early technologies, examining the peculiar nature of Hammeh slag, implications of ore-slag-ceramic mass balance calculations for reconstruction of the techniques, comparison between the two technological stages, and especially the sacrificial use of tuyères. Not only do these ceramics serve as tools to the technological processes proper, but they also play an important role in the technology itself. The high temperatures involved cause them to melt; this 'sacrifice' of tuyère ceramic contributes actively to the formation of the slag, thereby enhancing and/or facilitating the production of the metal.

It furthermore explores the role of the tuyères at both Hammeh and Beth-Shemesh within the framework of technological choice and craft production in an urban context. They are characterised by a uniform and distinct appearance, with a very uncommon square section that likely results from a local metallurgical tradition or technological choice. The quantity of tuyères and standardisation of their shape and size points to regular or even mass production, as opposed to just an 'experimental stage' of metallurgy.

The unique iron smelting and smithing material found at Tell Hammeh is not only important as a source of information for a very early iron smelting process, but allows an unprecedented insight into the intimate relationship between developments in metallurgy and ceramic technology as well.

P-43

POST-DEPOSITIONAL CHEMICAL AND MINERALOGICAL ALTERATION OF LATE BRONZE AGE CERAMIC ARTEFACTS (TRANSYLVANIA, ROMANIA)

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The study focuses on the post-depositional alteration recorded in the ceramic potshards found at the Bronze Age site of Ilisua, N Transylvania. The alteration processes are expressed by the formation of analcime, the re-hydroxylation and re-hydration of the matrix, the deposition of silica and the enrichment in P and S.

The analcime crystals show an angular shape, as they are newly grown at the expense of inclusions of volcanic glass shards. Alternatively, analcime may have been formed as well by the reaction of the vitreous ceramic matrix with the underground brines originating from Badenian salt diapirs occurring in the surroundings.

The re-hydroxylation process is reflected by the formation of smectite, while the re-hydration by the adsorbed molecular water is evidenced by the thermal analyses and the low total sum of electron microprobe analyses.

During the burial, thin layers of silica (opal?) lined the walls of pores and fissures. Rarely, the glassy matrix is slightly devitrified, probably also due to the burial in a humid climate of the area.

A high amount of phosphorus, ranging from 0.51 to almost 8% P_2O_5 as well as some Cl and S were identified in the matrix by microprobe and EDS, respectively. The relatively high amounts of phosphorus in the shards may be considered also as indication of burial contamination. Taking into account that the ceramic shards were discovered inside cremation tombs, it is most likely that phosphorus might at least partly originate from the dissolution of human ash by circulating groundwater. Partly, P might also originate from the soil during the burial. The chlorine content can be assigned to burial contamination due to brines, while sulphur might come from organic parts of the soil.

P-44

PRESERVING THE PAST: CUCUTENI CERAMICS ARTWORKS DISCOVERED AT SCÂNTEIA – IAŞI, ROMÂNIA

Codrin Lăcătuşu

For more than a millenium (4600 – 3500 B.C.), the culture of Cucuteni gave birth to a unique civilisation, which occupied a vast territory, including the S-E of Transylvania, almost the entire region of Moldavia, and a part of Ukraine.

In Romania, there are over 2000 Cucuteni sites, most of them being assigned to the first period of development, Cucuteni A, which was also the longest.

The archaeological material resulted from the diggings shows a vast range of ceramic typologies: household ceramics and cult ceramics, various antropomorph and zoomorph representations. The analysis of the decorative art of the Cucuteni ceramics betrays the existence of numerous kinds of ornamentation, starting with the deeply-cut bi-coloured ornamentation, characteristic to the first phases of the period Cucuteni A, and ending with the tri-coloured setting (white, red, black), specific to the Cucuteni culture. The setting is represented by geometrical forms (spirals, concentrical lines, criss-crosses, etc.).

The conservation – preservation of this heritage has been done extremely carefully, and supposed the collaboration of a great number of specialists from various fields (historians, archaeologists, chemists, physicists, biologists, etc.), first with regards to the investigation, as well as concerning the process of conservation – restoration itself. The work was done according to the five great principles accepted by the international community: the reversibility of the restorations, the visibility of the interventions, respect for the ancient techniques, the faithfulness of the setting and the compatibility of the materials.

Our interventions resulted in a long-term optimum conservation. The process of restoration has contributed to the discovery of archaeological information of the object and to a better understanding of its cultural significance, while preserving its physical, historical and aesthetic integrity.

P-45

ISSUES ASSOCIATED WITH ADHESIVES USED ON ARCHAEOLOGICAL POTTERY

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We aim to preserve archaeological artefacts for future generations. Repair often involves the introduction of an adhesive to the artefact. To minimize damage incurred by the artefact during this process, the adhesive should be reversible and have good ageing properties. Over the years conservation grade adhesives, such as Paraloid B72 have been identified. The aim of this study was to identify issues associated with the use of adhesives on archaeological pottery. A three-pronged approach was used: (1) Consulting archaeologists, conservators and manufacturers; (2) Testing analysis methodologies for identifying adhesives and (3) Identifying and assessing adhesives associated with artefacts.

Consultation revealed that one product that has been used by two participants had undergone a dramatic change in 1997 from a cellulose nitrate (easily reversible with acetone) to a polyurethane-based formulation (which is susceptible to rapid deterioration and can only be removed with great difficulty). Testing of analysis methodologies on known control adhesive samples, revealed the presence of an additional resin that has been added to what is considered to be a conservation grade product since 1995. This formulation change does not appear to have been detected. Adhesive samples were obtained from three Cypriot pottery artefacts. Analysis enabled adhesive identification, which was used to assess performance on the artefacts. Photographic documentation illustrates specific issues associated with particular adhesive types.

This study demonstrated the importance of consulting relevant practitioners, monitoring formulation and identifying and assessing adhesives used in the past. This will prevent the use of formulations that do not meet conservation criteria and that do not perform as expected. For instance, a product may age prematurely, not be easily removable or damage a significant artefact. It is more cost effective to adopt a preventive approach to the preservation of archaeological pottery collections, than to obtain funding for conservation treatments, to reverse the consequences of a product that should not have been applied in the first place.

P-46

CHEMICAL CLASSIFICATION OF THE SLIP LAYERS IN ITALIAN CERAMICS OF THE XVTH-XVIITH CENTURIES

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The use of slip layers as coating is typical of slipped/glazed and sgraffito ceramics from the XVth to the XVIIth century, produced in several localities all around Italy. In addition a slip coating can be present under the opaque glaze layer in majolica artefacts of some Italian centres. This work deals with the study of artefacts attributed, through stylistic approach, to important ceramic manufactures in central and northern Italy.

Representative samples have been analyzed for the purpose of characterizing and classifying their slip layers according to the chemical composition. Observations by optical microscopy on thin sections have been carried out in order to determine the structure and the average thickness of the slip and to obtain information on its application time, before or after cooking of the ceramic body. Scanning electron microscopy combined with energy dispersion spectroscopy (SEM-EDS) has been performed for individuating the chemical composition, which has been useful for classifying the slips and defining their provenance.

Investigations indicate that ceramic slip layers of the various production sites have always been produced using clays that turn white during firing, in accordance with their ornamental and functional role of covering and hiding the red colour of the paste. The slip layers were obtained from different raw materials, in contrast with the common idea of a unique source from Vicenza area, in north Italy. As a consequence it has been possible to reconstruct the areas where the same type of slip was used. For example a Mg-rich slip is used in several centres of Tuscany, while Mg-poor slips are characteristic of productions in north-eastern Italy. Chemical composition of the slip of slipped/glazed ceramics sometimes differs from that of majolica produced in the same productive centre. This difference could be explained with the hypothesis of a change in the position of clay excavation, or could suggest a different way of preparing the slip before its application.

P-47

X-RAY FLUORESCENCE ANALYSES OF POSTMEDIAEVAL GLAZED POTTERY FROM SOUTHERN MORAVIA

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The investigation of pottery with ionising radiation provides valuable information on its composition, provenance, and production technology. One of these frequently used analytical techniques is an X-ray fluorescence analysis (XRFA) that is based on detection of characteristic X-rays emitted by atoms of measured samples after exposure with X-rays or gamma rays. In comparison with most of the other analytical techniques, sample preparation is not necessary, XRFA instruments could be constructed as portable, and therefore in-situ analyses could already be performed during archaeological surveys. Although bulk analysis is not possible, because mean free paths of low energy X-rays in siliceous materials achieve only several tens or maximum couple of hundreds micrometers, analysis of the surface supplies information on composition of glaze, surface contaminants or corrosion products. Laboratory or in-situ XRFA represents an outstanding tool for the initial probe of various samples, because the analysis is non-destructive, easy to perform, multi-elemental, fast and relatively cheap. On the other hand, detection limits in XRFA are insufficient for searching for trace elements in some cases.

X-ray fluorescence analysis was applied to classification of pottery from Strachotin and Vacenovice area dating back to the end of 16th and the beginning of 17th century. These two localities were occupied by Anabaptists, who manufactured faiences beside common pottery. Faience is porous ceramics with white shards, made from a loam soil based ceramic mixture covered with lead-tin white and usually ornamented with painted decorating of several colours. The approximate composition of glazes and pigments was firstly determined with XRFA and then more accurate concentrations were obtained with an electron microprobe CAMECA SX 100. The impervious glaze contains tin, bismuth and arsenic compounds, which cause yellow up to auburn colouring of the glaze. Combination of nickel and cobalt compounds led to unusual greyish blue colouring of the glaze.

P-48

MINERALOGICAL AND GEOCHEMICAL CHARACTERIZATION OF GLASS LINED CERAMIC GLAZES FROM ARCHAEOLOGICAL SITE IN ILE-IFE, SOUTHWESTERN NIGERIA

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Recent investigation shows that glass and glass beads found in 10^{th} century excavation sites in Ife area south western Nigeria possess distinctive composition. There are low sodium, low magnesian high-lime, high-alumina glasses, with both lime and alumina greater than 10 wt% (now referred to as HLHA). The association of these glassess and beads with glass-lined mullite crucibles recovered in excavation sites in Ife shows that they were manufactured in or near Ile-Ife. Chemical investigation of the 35 crucible fragments shows that the fabric is characterized by a very high alumina content (25-35%), less than 3 – 3.5% K_2O, 1.5- 2% Fe_2O_3 and about 0.3 % each of CaO, Na_2O and TiO_2 identifying this as a particularly refractory material based on a very rich kaolinitic clay derived from a tourmaline bearing pegmatite widespread in the area. The data provides the first empirical evidence for the existence of a glass bead technology in Africa during the Classical period.

P-49

TECHNOLOGICAL FEATURES OF APULIAN RED FIGURED POTTERY

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Apulian red-figured pottery samples, dating back to the 5th and 4th centuries BC, from sites among the most relevant in central and northern Apulia - Monte Sannace (Gioia del Colle), Altamura, Conversano and Botromagno (Gravina), Canosa and Arpi - have been characterized from the physical-chemical, mineralogical and morphological points of view. Scanning Electron Microscopy, X-Ray Diffraction, X-ray photoelectron Spectroscopy and Atomic Spectroscopy investigations have been carried out on the ceramic body, red decorated area and black gloss of the objects, with the aim of outlining the technological features and of defining the nature of coatings and decorations. All 5th century objects, irrespective of sites, show the same features: fine texture of the ceramic body, red figures saved from the ceramic paste and black gloss painted directly on the ceramic body. As regards to the 4th century objects, some show similar features to the 5th century ones, however others are characterized by the coarse texture of their ceramic body and different technological expedients to obtain red decorations. The analytical results make it possible to distinguish different production technologies of red figured Apulian vases used at different sites in Apulia during the 4th century BC. These results add significant details to our knowledge on the production technology of one of the most important examples of pottery handcraft production in Magna Grecia of the 4th century BC. Moreover, the investigation has looked on the nature of the white and yellow overpaints. In fact, although the predominant colours of Attic and Apulian red figured vases are black and red, the potters made use of a limited range of additional colours. Among these, white and yellow are the most commonly used. The analytical results on the white "pigment" highlight the presence of meta-kaolinite, that allow us to hypothesize the use of kaolinite as raw material and its application on the vase before firing. Yellow pigment shows transitional characteristics between black gloss and white pigment (texture, sintering degree and chemistry) and analytical results are consistent with data reported in the literature according to which yellow was obtained by mixing the suspension of a very fine clay used for black gloss with kaolinite in 25/75 weight ratio.

P-50

RAMAN SPECTROSCOPY AS A TOOL FOR THE NON-DESTRUCTIVE CHARACTERIZATION OF SLIPS AND GLAZES OF A «SGRAFFITO» RENAISSANCE PRODUCTION

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Starting in the 15th century, a diffused production of «sgraffito» ceramics is attested in a large number of small artisanal furnaces in 15 sites in Tuscany, notably Castelfiorentino, Borgo San Lorenzo and Cafaggiolo. This production had already been investigated in 2004 by analyzing 30 samples, representative of open shapes (dishes, cups, bowls), covered by a white slip («engobe») and in most cases also by a transparent glaze. The chemical composition of both slips and glazes has been determined by means of SEM-EDS, and the mineralogical analysis of the pastes has allowed to hypothesize a firing temperature of about 950°C.

At present, Raman analyses have been carried out on the engobes and glazes of a few of the same samples, in order to verify the possibility to obtain the same or complementary information about raw materials and production technology of the artefacts in a completely non-destructive way. Raman spectroscopy has in fact proved itself to be a valuable tool for the non-destructive characterization of pottery pastes and glazes, as it allows a rapid and fairly straightforward identification of both crystalline and amorphous phases. Additional treatments on the Raman spectra of silicate glasses (such as ceramics glazes) allow to extract valuable information about their composition and firing temperature, which can in turn be related to the production technology of the studied artefact.

Two instruments have been used for Raman analysis: a Dilor XY2 spectrometer in macroscopic configuration, using a 406.7 nm Kr^+ laser and a CCD detector, and a Jobin Yvon Labram Infinity coupled with a 50x microscopic objective, Nd:YAG laser at 532 nm and CCD detector.

P-51

CHARACTERIZATION OF BYZANTINE GLAZED CERAMIC FINDS IN REPUBLIC OF MACEDONIA BY M-RAMAN SPECTROSCOPY AND SCANNING ELECTRON MICROSCOPY

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Byzantine glazed ceramics are one of the luxurious products of the Byzantine art work and it is assumed that they were imported in the Balkans, through the Aegean region routes. In order to achieve some understanding and characterization of the Byzantine glazed ceramic finds from the Republic of Macedonia, as well as to obtain technological information on the manufacturing of the objects, a pilot study, using μ-Raman spectroscopy and scanning electron microscopy, was undertaken.

Fragments of Byzantine glazed ceramics, all dated from 12th to 15th century, found in archaeological sites in Prilep and Skopje region were analysed. Archaeological evidences suggest the existence of local pottery workshops in those archaeological sites. The shards are all characterized by an underglaze engobe and sgraffito slip decoration. The ceramic glazes are in brown, black, dark green or ochre colour and some of them have specks.

According to the Raman spectra, the analysed glazes are rich in PbO and have low firing temperatures. However, the index of polymerisation (I_p) based on the peak area ratio (A_{500}/A_{1000}) related to the symmetric Si-O-Si bending (~500 cm^{-1}) and Si-O stretching (~1000 cm^{-1}) modes, gives possibility to identify different families of glassy silicate artefacts. The glaze pigments of the analyzed samples gave no significant Raman signature due to the possible dissolution of the metal oxides in the glass matrix.

Based on the results from the Raman spectra, the cross sections of selected shards were also analysed with scanning electron microscopy and the morphology and elemental compostion of the glazes, the characteristic underglaze engobes and the ceramic body, are discussed.

P-52

COORDINATION ENVIRONMENT OF LEAD IN COLOURED GLAZES FROM ANCIENT TILES: AN EXAFS APPROACH THROUGH THE PB L_3-EDGE

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High-lead soda-lime glazes used to decorate ancient ceramic tiles (Portuguese manufacture, XVI-XIX centuries) incorporate a diversity of cations [1] that modify various fundamental properties of the glassy matrix, particularly transparency and coloring. Lead has been studied in these materials by XANES at the *L*-edge to understand its role within the tetrahedral silica framework. The metal ion Pb^{2+} was found to be incorporated in the glassy matrix as a network modifier, whatever the glaze colour [2].

An EXAFS study at the Pb L_3-edge was also undertaken to ascertain the coordination environment and mean Pb–O distances in those ancient tile glazes. Spectra were collected with synchrotron radiation using the instrumental set-up of beamline BM-29 at the ESRF, in Grenoble, dedicated to XAFS experiments. Irradiated samples were small tile glaze fragments (brown and yellow). Collected data was deconvoluted with IFEFFIT program [3] and EXAFS spectra simulations were performed using the FEFF8 code [4]. The crystal structure of $PbTiO_3$ was used for the theoretical simulation of Pb L_3-edge EXAFS spectra. Ideally, the cubic perovskite-type structure with space group $P\ m\ \bar{3}\ m$ implies a cuboctahedral coordination (CN 12) of the large cation by oxygen and a regular octahedral coordination for the small cation; however, in the case of lead titanate, the crystal structure is distorted to tetragonal symmetry (space group $P\ 4\ m\ m$) and the Pb^{2+} ion assumes a less regular environment, more favorable to accommodate the lone-pair of $6s^2$ electrons.

Fitting results corroborate a high coordination number for the first shell of oxygen atoms around Pb^{2+} ions in all studied glazes, with a good approximation to the distorted polyhedron observed for lead in the chosen model compound.

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P-53

COMPARATIVE STUDY ON BLUE PIGMENT OF CHINESE BLUE AND WHITE PORCELAIN AND ISLAMIC GLAZED POTTERY 12TH-17TH CENTURY

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Blue-and-white porcelain constitutes the largest amount of porcelain exported in *Chinese* history. However, at least in the early phase it was Islamic glazed pottery that manifestly influenced the figuration, decoration and even the size of Chinese blue-and-white porcelain, to the extent that Chinese potters used Arabic calligraphy as decoration for porcelain. The laboratory tests on large samples of Chinese blue-and-white porcelain produced in the Yuan and Ming dynasties (AD 1271 – 1644) was taken and the results revealed that the blue pigment underwent a major shift around 1425 AD. The chemical composition of blue pigment used before 1425 didn't match any mineral produced in China. From this the inference can be drawn that foreign pigment was imported during the early period of blue-and-white porcelain production, most probably from Turkey or Iran, since the technique of painted blue pigment decoration was first developed in early Islamic ceramics. All of these indicate that the emergence of blue-and-white porcelain had a very close relationship with Islamic ceramics, which had already reached a high level of development by the Middle Ages.

Around 30 pieces of Islamic glazed pottery, which were produced in Syria, Iran and Egypt in 12th – 16th century were studied. The result of chemical composition shows that these samples could be divided into 4 groups. 2 of them show high copper in blue pigment. Copper was probably one of the main colouring elements that lead to blue, which shows a great difference from contemporary Chinese Blue and White porcelain, which show very little if any copper in the pigment. In these latter pigments the blue colour was achieved by cobalt and iron. However, one group shows quite similar chemical composition to a blue pigment used in China before AD 1425. It indicates that the assumption according to which China imported blue pigment from Mid-East in an early stage is reasonable and compellent. On the other hand, the diversity of blue pigment used on Islamic ceramics reveals that there were several ceramic-making systems existed in the mid-east at that period and different areas probably used different pigments.

P-54

LOCAL POTTERY PRODUCTION AND INTERREGIONAL EXCHANGE IN MIDDLE HELLADIC BOEOTIA: THE EVIDENCE FROM ORCHOMENOS

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In an effort to investigate local pottery production in Boeotia and interregional exchange during the Middle Helladic period (ca. 2000-1675 BCE) this paper examines the integration of petrographic data to fine-grained stylistic classification of monochrome burnished grey, yellow, brown and red ('Minyan'), mattpainted and polychrome wares excavated at the archaeological site of Orchomenos. Emphasis is put on the detailed technological and compositional study of Grey Minyan pottery, both the fine ('True Grey Minyan') and coarse ware groups, so as to assess the potential role of Orchomenos as an important potting centre in Boeotia. Regarding issues of provenance, the identification of local fabric groups proved to be challenging as the geological landscape around Kopais basin, as evidenced by geological prospection and subsequent experiments, is quite varied with a range of limestones and flysch lithologies with ophiolite outcrops. Furthermore, 'local' coarse petrofabrics, manufactured with calcareous-poor clays, show a great degree of compositional heterogeneity which does not parallel the stylistic classification scheme. It appears that more than one workshop was involved in the production of these wares. The analytical data also confirms the presence of imports from Aegina, the Cyclades, and mainland Greece and attests to Orchomenos' participation in interregional exchange.

P-55

MINERALOGICAL AND PETROGRAPHICAL STUDY OF CELTIC HOUSEHOLD CERAMIC FROM BRATISLAVA`S OPPIDUM (SLOVAKIA)

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Twenty-five fragments of Celtic household ceramics, such as pots, bowls and tripods, excavated from various archaeological sites in Bratislava were studied by polarized light optical microscopy (OM), X-ray powder diffraction (PXRD) and scanning electron microscopy (SEM). Macroscopically, the shards were divided into thin-walled (6 mm thickness) and thick-walled ceramics (12 mm). The thin-walled shards have a red-colored ceramic body, with the surface decorated with red paintings, while the thick-walled shards are usually black or grayish, only occasionally exhibiting incised surface. Granulometric analyses show that thin-walled shards belong to semi fine and fine categories, whereas the thick-walled shards belong to coarse ceramic. PXRD and optical microscopy reveals details on the mineralogical composition of the ceramic body as well as the thermal changes due to the firing. The ceramic body consists of a thermally transformed clay matrix in which various temper grains occur. The temper consists of quartz, feldspars, micas and rock fragments, e.g. biotitic and sillimanite-gneisses with graphite. Additionally, the thick-walled ceramics contains a large amount of graphite.

The matrix structure and the distribution of temper indicate a possible style of shaping the vessels. Consequently, the thin-walled ceramics were wheel-thrown on potter's wheel, while the thick-walled ceramics were probably made by slab building technique and also characteristic features of wheel-fashioning methods were also observed. Based on the thermal changes of the mineral phases as noticed in thin section and the changes of the XRD patterns, compared with references data, we can estimate that the firing temperature reached 600 °C and 800 – 900 °C for the thin-walled ceramics, and maximum 900 °C for the thick-walled ceramic respectively.

As the thin-walled ceramics do not contain large temper grains, we presume that they were made from washed clays but there is no way to pinpoint the geological source of the raw materials. In the case of the thick-walled ceramics the graphite temper could originate from the southern part of Bohemia, where graphite deposits occur. Additionally, in the ceramic shards, in thin sections, metamorphic fragments similar to those found in the surroundings of the graphite deposits were also identified.

P-56

BRONZE AGE POTTERY FROM TRANSYLVANIA (ROMANIA): A MINERALOGICAL STUDY

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Middle Bronze Age ceramic potshards found in NW Transylvania (Romania) were studied by plain-polarized light microscopy, XRD, SEM, DTA-TGA and electron microprobe. Microscopically the ceramic body consists of a clayish matrix, in which nonplastic inclusions and voids occur. Various fabrics of matrix can be seen, as function of firing temperature: microcrystalline, microcrystalline-amorphous, amorphous-microcrystalline and amorphous. The inclusions are represented by various crystalloclasts (quartz, plagioclase feldspar, muscovite, calcite, and heavy minerals), lithoclasts (quartzite, micaschist, gneiss, andesite, rhyolite, granite, granodiorite, sandstone, clay) and grog. Granulometrically the samples are either semifine or coarse. The major and trace element analyses show a homogeneous chemical composition: 66-69% SiO_2, 14-15% Al_2O_3, 5-6% Fe_2O_3, ~1.4% MgO, ~2% CaO, ~1% Na_2O, ~ 2% K_2O, <1% TiO_2, <0.4% P_2O_5. Relatively high amount of Au (4.5-5.2 ppb, Th (7.8–11.1 ppm) and U (1.7-3.1 ppm) as well as REE, may be explained by the adsorption capacity of the raw clays. The source of these elements could have been the metamorphic rocks of the Meses Mts. and the Neogene volcanics of the Eastern Carpathians, respectively. The high value of LOI, ranging from 2.6 to 6.6%, is due to burial alteration.

BSEI shows the presence of new phases, such as melt and reaction rims, as well as newly-formed feldspars. Based on optical microscopy, the modification of the XRD lines of clay minerals, SEM and thermal analyses, a large range of firing temperatures between 750 and 950°C was inferred. Most likely reddish Pleistocene clays occurring west of the site were mixed with alluvial sands from the nearby-located river to obtain the ceramics.

P-57

THE PHYTOLITH ANALYSIS OF CERAMIC THIN SECTION. A BRIEF INTRODUCTION

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Phytolith might be one of the objects observed during the description of the potsherd in thin section. Apparently, their presence, distribution and spectra may vary from one ware to another. Such variations were recorded during an extensive study of the collection of thin sections from the ceramic of the ed Dur site (Um al-Quaiwan, U.A.E.). These observations contributed to the classification of the pottery into local and non local productions as well as to refine the identification of the clay sources of the local productions (De Paepe *et al* 2003; Vrydaghs *et al* in press). However, by recording the presence of phytolith not reported by the phytolith analysis of classical samples, it also contributes to palaeoenvironmental reconstruction (Vrydaghs *et al* in press).

The description system is fundamental to address the archaeological and palaeoenvironmental topics. The purpose of the present contribution is to introduce the system we adopted. It relies on the analytical scheme we set up for the phytolith analysis of the soil thin sections (Vrydaghs *et al* 2007). So far four aspects, labelled as indexes, are considered:

- the absence or presence of the phytoliths (or A/P index);
- the morphotype identification (or M index);
- the conservation of the phytoliths (the C index). This index consider the preservation of the phytoliths and their relative distribution being either in the paste or in the voids (contiguous or isolated);
- the distribution of the phytoliths within the paste or within the voids (or D index).

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P-58

VASES FOR CHILDREN IN MYCENAEAN GREECE

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Several vase forms in the Mycenaean ceramic repertoire are generally considered to be related to children, either due to their small size (miniature vases); or because of their shape (bird shaped askoi and zoomorphic vases) or on account of a special morphological feature, as in the case of the side-spouted jars generally interpreted as feeding-bottles.

The aim of this paper is to analyse these vessel types from various angles in order to establish if they are indeed especially characteristic to children or not.

For this purpose, first closed grave assemblages containing burials with known age and associated with these vessel types are examined. The picture emerging from the analysis is far more complex than was previously thought. Some of the vase types can be found with adult burials as well. Others however, show a gender-specific distribution, occurring in burials of girls and adult females. Even in case of those types, which were found only in relation to child burials, the results of the analysis show a more elaborate distribution pattern within the age-group of children.

After the observations made on age- and gender-specific distribution patterns of these vases, other aspects, such as morphological characteristics, variations in size, regional distribution and results of previous organic residue analysis conducted on these vessel types was also explored. The examination of these aspects reveals some further details concerning the burial association of these vases. For example in the age distribution patterns of some of the vase shapes, regional differences can be observed between the centre and periphery of the Mycenaean world.

P-59

CONSERVATION AND TECHNOLOGY; OBSERVATIONS ON THE VÖRS-MÁRIAASSZONY SZIGET POTTERY ASSEMBLAGE

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Vörs-Máriaasszony sziget is a multi-period archaeological site in SW Hungary. The finds from the site are currently being assessed by a team of archaeologists and interdisciplinary experts within the framework of the National Science Foundation grant OTKA- T-046297. This project was also a part of regional sediment studies in a German-Hungarian collaboration project reported on by H. Taubald (L-35).

The conservation of the Vörs pottery was an integral part of the scientific elaboration procedure. Documentation and analysis were made in a GIS-based information system, including analytical information. During the conservation procedure, a register of decoration techniques used was made. We tried to reproduce these techniques experimentally by using potential local clay resources. Morover, we tried different firing temperatures and heating times, together with the most typical tempers used on the site as determined by previous ceramic petrological studies. The resulting ceramic bodies were subjected to further petrographic analysis. Results of the experimental studies will be used in the final evaluation and restoration processes.

P-60

PETROGRAPHIC AND GEOCHEMICAL INVESTIGATION OF THE KURA-ARAXES WARE FROM SOS HÖYÜK, EASTERN ANATOLIA

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Handmade, red-black burnished Kura-Araxes ware (also known as Early Transcaucasian ware) is the hallmark of the Early Bronze Age Kura-Araxes culture that was the most widespread prehistoric culture in the Near East. The spreading phenomenon, from northeast Caucasus to the Levant and its mechanism was the object of numerous researches, in terms of theoretical and archaeological view. Limited archaeometric investigations concerning this subject exist.

In this study we present petrographic and geochemical analyses of selected samples of the Kura-Araxes wares from Sos Höyük, located in Erzurum district in Eastern Anatolia. The main aims are to determine the provenance and the production pattern of the Kura-Araxes pottery during the Late Chalcholithic to the Middle Bronze Age (ca. 3500-1500 BC). The results will be discussed in light of the socio-economic organization in this region and compared with the results of previous works in other regions (e.g. Amuq Valley, Malatya region, Godin Tepe in central western Iran).

Archaeometrical results suggest that the analyzed samples were locally produced, most probably for household use. In relation to the ceramic tradition and socio-economic organization, our data are comparable to those of previous works from Amuq valley, Malatya region and Godin Tepe. Contrary to these regions, in Sos Höyük there has been no technological innovation or changes in the ceramic production during the Late Chalcolithic to the Middel Bronze Age, which indicates new comers to the region.

P-61

TECHNOLOGICAL EXAMINATION OF BADEN-POTTERY FROM BALATONŐSZÖD-TEMETŐI DŰLŐ, BADEN SETTLEMENT

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A rescue excavation was carried out on the planned route of M7 motorway, near the village of Balatonőszöd, during 2001-2002. On 100,000 m^2 an extended settlement-part of Late Copper Age Baden Culture was excavated. On the basis of ceramic-typological investigations (in the system of Nemejcová-Pavúková) it was concluded that the settlement existed from the IB-C (Boleraz-phase) to the Classic phase III. The settlement's life began around 4680 BP, and closed around 4110 BP.

35 samples were chosen for petrographic analysis, among them there are pottery-fragments (jugs, cheeres-cups, bowls, amphorae, cooking-pots, storage vessels) both from the Boleraz and the Classic phase. Selected pottery fragments were studied macroscopically and then were subjected to thin section analysis.

The main aim of the authors was to group the pottery samples according to their petrographic properties, compare these groups with the groups defined by archaeological examinations, and - where possible - make comments on ceramic-making technology.

All of the samples are tempered deliberately with grog, although potters did not always use the same amount. The majority of the samples contain carbonate sand besides grog fragments, while other samples are carbonate free. In two sherds volcanic rock fragments were also detected.

Petrographic investigation showed that during the examined period there were more pottery-making recipes in use. The presence of the volcaninic rock fragments in two sherds might refer to the use of at least two different kinds of raw material.

Comparison with archaeological description of the sherds showed that differences in composition and fabric of the investigated ceramics are not in connection with chronological and archaeo-typological differences.

P-62

DAUB: BETWEEN POTTERY AND SEDIMENT

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The poster presents the summary of a complex archaeometrical investigation of Neolithic daub fragments from two archaeological sites (Vörs and Kup, in Transdanubia, Hungary).

Daub is the term used for different parts of a wattle-walled house (wall, floor, kiln), which can be preserved by occasional or intentional burning of the building. Considering the raw material - fine grained sediments - and the preparation - the use of artificial temper, but the lack of intentional burning - daub is indeed somewhere between the sediment and the pottery so their comparison may provide additional information about the preparation of both artefacts.

The main target of this research was to collect information about the building technology of the wattle-and-daub houses, tracing possible differences between the building traditions of different cultures and localities and to investigate the relation of daub to other, intentionally burnt earthenware (ceramics) on the same sites. The analytical program was based on macroscopic and thin section petrography, accompanied by chemical analysis (XRF and NAA) and SEM-EDS analysis. Furthermore, soil samples, collected from the archaeological sites were analyzed by stereo microscope and X-ray powder diffraction, and the chemical data of soil and ceramic samples from Vörs were used for comparison. The investigation proved that the raw materials were local fine-grained (silt - fine-sand) sediments but the raw material of the ceramics occurring at the same locality was different.

The lack of clay minerals in the material suggests that - in contrast to the pottery - not the clay minerals but the very fine grained (μm sized) fraction was required to gain the proper stability of the wall. In some cases the amount of the finer (10-20 μm) fraction was artificially increased.

According to the high variability of the P content and the organic remnants organic material was used for increasing the stability and plasticity of the wall.

Textural differences within the daub samples of the same site arise from the different original position of the fragments in the house.

Painting of the external surface of the wall was observed in several instances, probably for decoration and for the protection of the wall surface. Bone-grit was applied for producing the colouring matter.

CONFERENCE EXCURSIONS

Excursion No. 1. Százhalombatta

Guide: Attila Kreiter

- **"Matrica" Museum and Archaeological Park**

Website: http://matrica.battanet.hu
Százhalombatta lies on the right bank of the Danube, 30 km south from Budapest. Due to its favourable geographical position it was occupied since the Neolithic. The "Matrica Museum" has been receiving visitors since 1987. The small regional collection has grown into a town museum of European fame where - beside scientific research - serious public museum education is carried out. The Museum bears the Roman name of the settlement: "Matrica", which was flourishing for 300 years between the 1st and the 4th centuries AD.
The Museum organises 5-6 special exhibitions a year with lectures, museum-pedagogical programs, playhouses and craftsmanship programmes connected to them. During the summer performances and concerts are presented in the museum yard.

- **Archaeological Park at Százhalombatta**

The Archaeological Park, the first open-air museum of prehistory in Hungary, opened in 1996. The park was established amongst the 2700 year old (Iron Age) tumuli which gave the name of the town (Száz halom = hundred barrows). Within the park authentic reconstruction of Bronze and Iron Age houses, ovens, auxiliary structures were built. These reconstructions were based on remains of excavated buildings, post-holes, wall remains, floors, hearths and collapsed roof beams. A team of archaeologists, architects and craftsmen rebuilt the houses and auxiliary buildings found in Százhalombatta and its surroundings. Scientific research on experimental archaeology and reconstruction of prehistoric environment are also carried out in the park. The main focus of experimental archaeology is on building constructions and Bronze Age pottery production.
In the park visitors may also practice prehistoric crafts such as spinning, weaving, building hedges, manufacturing clay vessels or Iron and Bronze Age jewellery. Visitors may also try dishes, which are made according to prehistoric recipes. They also offer baked cake made from spelt grown in the park.
Under the barrows, found within and around the park, from the 7th-6th centuries BC, the elite of the Hallstatt culture were buried. The dead were cremated and the ashes were placed in urns or in wooden grave chambers. On the southern edge of the field of barrows, a sensational architectural find, the most well-preserved barrow No. 115 is reconstructed. Archaeologists managed to reconstruct the original chamber of the passage grave made of oak 2700 years ago, where the visitors may

get acquainted with the burial rites of the period through a multilingual multimedia program accompanied by sound and light effects.

- **The Bronze Age tell and Iron Age rampart of Százhalombatta**

Several important Bronze Age sites are known around Százhalombatta. The most important is a tell settlement (Százhalombatta-Földvár) situated on an elevated loess plateau by the Danube. The tell is 200 metres long and 100 metres wide. The settlement was established in the Early Bronze Age (Nagyrév culture) around 1800 B.C. In the Middle Bronze Age a ditch and rampart system was built around it by the Vatya culture. The site belongs to a series of 28 known fortified settlements of the Vatya culture enclosing an oval distribution area of the Vatya in Transdanubia and the Danube-Tisza interfluve. Later in the Iron Age a rampart (Sánchegy) was built north, north-west from the tell. West, south-west of the rampart one of the largest tumulus cemeteries of Transdanubia can be found. The tumuli were built along the roads leading to the earthwork. Several excavations took place at the tell (1969, 1989-1993) and a recent excavation is part of the major international research project 'Emergence of European Communities: Household Settlement and Territory in Later Prehistory' (http://www.eoec.org).

Excursion No. 2. Hódmezővásárhely

Guides: Katalin Bruder, Veronika Szilágyi

Hódmezővásárhely is a rural city in the South-Eastern part of Hungary, in the middle of the vast lowlands known as Alföld (Great Hungarian Plain). The first inhabitants of the area date back to
Palaeolithic times (Csongrád-Felgyő, Middle Palaeolithic stray finds, Szeged-Öthalom, Epipalaeolithic hunters of the so-called East Gravettian cultural complex), but the continuous habitation of the area started from the turn of the 7^{th} / 6^{th} Millennium B.C., with the Early Neolithic Körös culture. One of the keys of success here was the excellent potters' clay cropping out at many places, giving a basis of extended ceramic arts from prehistory until today. The environs of Hódmezővásárhely has been for long millennia a centre for the art of pottery and ceramics. World famous pieces of prehistoric, migration period and mediaeval ceramics are known mainly from the archaeological evidence. Following the Turkish occupation period, mainly glazed pottery with versatile forms and decorations were made. This tradition yielded a popular tradition of folk art living and flourishing until today.

- **Colony of Ceramic Artists**

In recent years the city of Hódmezővásárhely undertook the task of giving a home for this ancient and modern art. The faience factory called 'Majolica Works' was founded here in 1912 by prominent artists of the period: János Tornyai, Béla

Pásztor and Ferenc Medgyessy. By the 1960's the professional expertise and tradition of the people living in Hódmezővásárhely gave a solid foundation for the largest ceramic and porcelain complex in Central Europe called Alföldi Porcelángyár (Alföld China Factory) The factory turned into a number of independent factories and workshops after the political change in the early 1990's. Supported by the factories, the Vásárhely Ceramics Symposium operates since 1998, attracting professional artists from Hungary and various countries all over the World. The artists are supplied with working facilities, raw materials and most up-to-date technology by the five great ceramic factories in the city - the Alföld China and Tableware Closed Corporation, the Villeroy & Boch Hungary Ltd., Keram-Pack Ltd., the Industrial Silicate and Artistic Ceramics Producing Ltd. and the IMERYS Hungary Fire-Clay Ltd.
The city has obtained one selected piece of art from each artist every year. The collection has come up to about 180 pieces during the past decade. A selections from the material of the Hódmezővásárhely Ceramic Museum was presented on various exhibitions in Hungary and abroad. Beside the Ceramics Symposia in Hódmezővásárhely a permanent Colony of Ceramic Artists was established in permanent operation since January 2006.

- **Tornyai János Museum, Hódmezővásárhely**

The city museum at Hódmezővásárhely was named after a prominent Hungarian painter from the 20th century He was himself a founder of an artist colony of international fame. Naturally, the museum has permanent exhibition on painting and arts, the object of our visit, however, is one of the best exhibitions on Neolithic pottery and art in Europe.

Everyday Venuses

The city museum of Hódmezővásárhely can take pride in hosting the only permanent exhibition in Hungary dedicated entirely to Neolithic pottery of the region. It is not by mere chance as the environs of the city is especially rich in world famous archaeological sites dated to the early millennia of farming economies. Starting from the first Neolithic communities of the Carpathian Basin, the people of the Körös culture inhabited the area from the turn of the 7th and the 6th Millennium B.C. The settlement network was exceptionally dense, surpassing that of a modern habitation pattern. The houses of the period are known, apart from excavation ground-plans, from clay house models as well. The pottery of Körös culture was of surprisingly complex wealth of form, good finish and fine decoration including (typically red) painting, plastic ornaments with animal figures and anthropomorphic representations. The subsequent Neolithic cultures also contributed to the art of the period by famous find assemblages like the seated male and female gods with special attributes from Szegvár-Tűzköves, the seated goddesses and abstract representations from Hódmezővásárhely-Kökénydomb.

Beautiful instances of ceramic art are the large vessels with human face, storing and guarding the precious crops. The typical settlement forms of the Late Neolithic here are the tells, comprising several meter thick cultural deposits. One of the most intensively studied tell settlements is Hódmezővásárhely-Gorzsa, presented in details on the exhibition.

Excursion No. 3. Herend, Városlőd, Veszprém

Guide: Katalin T. Biró

The environs of the beautiful historical city of Veszprém in the heart of the Bakony Mountains are famous about their crafts and art. The intra-mountain basins of the Bakony Mountains supply the potters with good quality clay, utilised since prehistory. The world famous china factory, Herend, however is working on imported kaolinitic raw material since the first half of the 19th century. Városlőd produces excellent majolica ware.

- **Herend Porcelain Museum**

Website: http://www.museum.herend.com

The Herend factory was founded in the beginning of the 19th century. The idea of collecting and displaying porcelain pieces made at Herend was raised in the times of Mór Fischer, also owner and founder of the Tata majolica factory. He was an eminently inventive and creative designer, and an inveterate collector, who preserved examples of almost everything produced. The current collection of the museum is based on his original pieces, growing together with the advance of the factory. Herend obtained various medals and merits on different world expos and it is still the most famous and widely traded porcelain of Hungarian origin. The factory museum was opened to the public just before the First World War. The present Herend Porcelain Museum opened in 1964 after restoration of the building. The permanent exhibition presented highlights from the history of the manufactory and displayed popular and lesser-known forms and patterns, picking out some items that excelled for their size and technique or other characteristics. Apart from the collection of porcelain, there was a display showing stages in the technology used in hand-made porcelain manufacture. This fascinating aspect of the Herend Porcelain Manufactory is now presented in a working, operating Mini-Manufactory, to be found in the Porcelanium Visitor Centre, just across the square from the museum.

- **Keramika Városlőd (Majolica Manufacture)**

Website: http://www.keramika-kft.hu/

The confines of Városlőd yielded a wide variety of clay, known and used for the production of pottery since prehistory.
600 years ago the Carthusian monks made here tiles, terracotta wares and building ceramics. Some 300 years ago, a colony of potters settled here. Wenczel Stingel, founder of the Herend Porcelain factory established here a potters' workshop, specialised on majolica and stoneware. They used to employ over 100 craftsmen and traded all over the world. They were also making pipes as well as building and industrial ceramics. After the IInd World War, part of the equipment and the firm itself was overtaken by Herend.
The local traditions were revitalised by the 1990-ies, and production started at Városlőd again.

- **Laczkó Dezső Museum, Veszprém**

Website: http://www.vmmuzeum.hu/

Veszprém is one of the oldest and most beautiful cities in Hungary, the "town of Queens". Its emblematic townscape with the 'viaduct' is an especially memorable sight. It is also the home of one of the oldest and richest county museums, named after the geologist-palaeontologist Dezső Laczkó who discovered the 'pebble-tooth pseudo-turtle', (*Placohelys placodonta*), one of the most notable fossils in Hungary. He also took part in the first excavations of the eminent Upper Palaeolithic open-air site, Ságvár.
Archaeology has always been one of the strong profiles of the museum. Its current permanent exhibition, 'Spirit of the object… the place… and the image' gives an overview of the archaeological as well as historical heritage of an area with immensely rich cultural tradition.

INDEX

Index by authors

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