



UNIVERSITÀ  
DI TRENTO

# IMEKO TC-4 International Conference on METROLOGY FOR ARCHAEOLOGY AND CULTURAL HERITAGE

VIRTUAL CONFERENCE - OCTOBER 22, 24, 2020

## MetroArcheo2020

Virtual Conference

For further information, visit the website  
[www.metroarcheo.com](http://www.metroarcheo.com)

# PROCEEDINGS

2020 IMEKO TC-4 INTERNATIONAL CONFERENCE ON

**METROLOGY FOR ARCHAEOLOGY  
AND CULTURAL HERITAGE  
PROCEEDINGS**

October 22 - 24 2020 | Virtual Conference

© 2020 IMEKO

**ISBN: 978-92-990084-9-2**

All rights reserved. No part of this publication may be reproduced in any form, nor may it be stored in a retrieval system or transmitted in any form, without written permission from the copyright holders.

# MetroArchaeo 2020 Committee

## GENERAL CO-CHAIRS

Pasquale Daponte, *University of Sannio, Italy*

Stefano Gialanella, *University of Trento, Italy*

Dario Petri, *University of Trento, Italy*

## TECHNICAL PROGRAMME CO-CHAIRS

Michele Fedel, *University of Trento, Italy*

Annalisa Pedrotti, *University of Trento, Italy*

Fabio Santaniello, *University of Trento, Italy*

Marco Zanatta, *University of Trento, Italy*

## INTERNATIONAL PROGRAM COMMITTEE

Emma Angelini, *Politecnico di Torino, Italy*

Fabrizio Antonelli, *LAMA - LabCoMaC - Iuav University of Venice, Italy*

Lucio Calcagnile, *University of Salento, Italy*

Franco Cambi, *University of Siena, Italy*

Stefano Campana, *University of Siena, Italy*

Piergiulio Cappelletti, *University of Naples, Italy*

Luca Cappuccini, *University of Florence, Italy*

Paolo Carafa, *University of Roma La Sapienza, Italy*

Lorenzo Ciani, *University of Florence, Italy*

Juan Antonio Quirós Castillo, *Universidad del Pais Vasco, Spain*

Andrea Cataldo, *University of Salento, Italy*

Cristina Corsi, *University of Cassino and Southern Lazio, Italy*

Giuseppe Cultrone, *University of Granada, Spain*

Egidio De Benedetto, *University of Salento, Italy*

Lucio Del Corso, *University of Cassino and Southern Lazio, Italy*

Zaccaria Del Prete, *Sapienza University of Rome, Italy*

Maria Grazia D'Urso, *University of Bergamo, Italy*

Francesco Fontanella, *University of Cassino and Southern Lazio, Italy*

Venice Gouda, *National Research Centre, Egypt*

Sabrina Grassini, *Politecnico di Torino, Italy*

Francesco Lamonaca, *University of Sannio, Italy*

Marco Laracca, *University of Cassino and Southern Lazio, Italy*

Giovanni Leucci, *Istituto di Scienze del Patrimonio Culturale (ISPC-CNR), Italy*

Paolo Liverani, *University of Florence, Italy*

Carmine Lubritto, *Università degli Studi della Campania "Luigi Vanvitelli", Italy*

Marilena Maniaci, *University of Cassino and Southern Lazio, Italy*

Lara Maritan, *University of Padova, Italy*

Paola Moscati, *Istituto di Scienze del Patrimonio Culturale (ISPC-CNR), Italy*

Alessandra Pecci, *University of Barcelona, Spain*

Giacomo Pardini, *University of Salerno, Italy*  
Emanuele Piuzzi, *Sapienza Università di Roma, Italy*  
Eugenio Polito, *University of Cassino and Southern Lazio, Italy*  
Gianluca Quarta, *University of Salento, Italy*  
Carmen Maria Roskopf, *University of Molise, Italy*  
José Antonio Barrera Vera, *University of Seville, Spain*

# MetroArchaeo 2020 Plenary Speakers

Thursday, October 22, 2020 – 10:00 CET

## Early Pyrotechnology: Lithic Heat Treatment

Patrick Schmidt

*University of Tübingen, Germany*

### ABSTRACT

Heat treatment of silica rocks chert and silcrete is one of the oldest transformative technologies used to alter the properties of materials. Its first use dates back to the southern African Middle Stone Age (MSA), and several examples are known from the Asian and European Upper Palaeolithic and Australia. The research questions associated with heat treatment are related to its purpose for tool manufacture, the investment in time and resources needed for it or the social and cognitive capacities it requires. Intensive research on these questions has been conducted for almost ten years now. In this presentation I will summarise the most recent progresses and discuss the methodological developments.

### SPEAKERS BIOGRAPHY

**Patrick Schmidt** works at the interface of prehistoric archaeology and mineralogy. Research topics are the spectroscopic signature of minerals, the properties of archaeo-materials, mineralogy and crystallography of raw materials, provenance studies and stone heat treatment. His main focus lies on silica minerals like quartz, opal-CT and moganite, and siliceous rocks like flint, chert and silcrete.



Friday, October 23, 2020 – 09:30 CET

## **In-situ differentiation of black rock paintings in the palaeolithic caves**

Ina Reiche

*Research director at PCMTH team, Institut de recherche de Chimie Paris (IRCP)  
Centre de recherche et de restauration des musées de France (C2RMF)*

### **ABSTRACT**

Prehistoric cave art represents a key marker for a better understanding of the evolution of mankind. Interdisciplinary approaches using methods from archaeology, geology, biology, chemistry and physics have addressed many questions about the environment of these archaeological sites, the dating and the material nature of the decorated walls. The combination of these results allowed the field to reach conclusions about the cultural and technical practices and improved our knowledge of our distant ancestors. However, cave art still remains mysterious, despite the fact that it has been the subject of many interpretations.

Physico-chemical analyses of the painted works have also been applied for thirty years to the archaeological parietal representations, such as those found in prehistoric caves. The analysis of the constituting materials of these drawings and paintings (nanosized iron oxides for the reds and yellows, nanocrystalline manganese oxides and charcoal for the blacks) ultimately reveals characteristics that provide insight into the artistic techniques and cultural practices of prehistoric humans. Analysing cultural materials also gives information on alteration processes. The knowledge acquired this way is valuable, as it provides original information that is impossible to obtain by another means.

The availability of new and advanced physicochemical techniques allowed for a renewal of the research on cave paintings. The research started with analyses carried out on samples from the paints, archaeological artefacts and raw material. They showed the existence of precise recipes of "paint pots" consisting of pigments, extender and binder. In some cases, the results allowed for an analysis of the creation sequence of the prehistoric figures. In other cases, the pigments were differentiated depending on characteristics related to their geological origin (trace elements).

Elementary analyses are used to answer questions such as the differentiation of parietal representations presenting the same mineralogical phase, the origin of raw materials, or the determination of the sequence of production.

The fragile nature of cave art has been known since its discovery. Strict conservation procedures have been applied to protect these UNESCO world heritage listed paintings. The awareness of the fragility of important cultural artefacts has led to a rapid transition from destructive studies to micro-sampling and then finally to non-invasive analyses, carried out in situ. Thus, portable X-ray diffraction, Raman spectroscopy and XRF have been used for the characterization of the paint layers directly. However, portable technologies are still not as efficient as their lab-based counterparts. Their sensitivity and precision

frequently lower than the methods available in the lab. Additionally, the differentiation of the compounds in the pigments from those in the wall is difficult because the colouring matter analysed on the cave walls is not geometrically regular nor chemically homogeneous, both laterally and in depth. Taphonomical phenomena may also contribute to the heterogeneity of the chemical composition of the paint layer and the wall substrate. Encouraging results have however been obtained in several studies, due to an active methodological research on these techniques.

In particular, p-XRF enables determining the geochemical signature of colouring matter, helping to answer archaeological questions without altering the work under study. For black pictorial layers based on manganese oxides, it was possible to develop a semi-quantitative analytical protocol that allowed the differentiation of black prehistoric figures in the case of the Rouffignac and Font-de-Gaume caves in Dordogne, France. This is all the more important in the absence of a direct dating of the figures made with three types of manganese oxides as it is the case at the Rouffignac cave. The research is carried out thanks to the combination of non-invasive chemical analyzes using X-ray fluorescence in situ as well as the stylistic study and that of the overlays of the figures. In the absence of a general organization of the panel of the Grand Ceiling of the Rouffignac cave it was possible to show that all of the figures were produced in stages in small subsets by small groups of humans. This is consistent with the creation of the friezes, in particular that of the ten mammoths present in other galleries of this cave by a small group of prehistoric artists.

## SPEAKERS BIOGRAPHY

**Ina Reiche:** research director at PCMTH team, Institut de recherche de Chimie Paris (IRCP) - Centre de recherche et de restauration des musées de France (C2RMF) - UMR 8247 CNRS

- Degree in Chemistry and bachelor in Art history: 1997;
- PhD in Material Science: 2000;
- Researcher at the Rathgen research laboratory, National Museums in Berlin, Prussian Cultural Heritage Foundation: 2000-02;
- Researcher at French National Research Council (CNRS) from 2003;
- Habilitation in Analytical Chemistry: 2009;
- CNRS research director since 2012;
- Head of the Rathgen research laboratory (on leave from CNRS): 2014-19;
- Research fields: Archaeometry of historical and archaeological biominerals (bone, ivory, antler, corals) as well as pigments, glass and minerals. Identification and understanding of alteration processes by using analytical methods such as synchrotron methods, ion beam analysis and other laboratory and mobile equipment, especially Raman and X-ray fluorescence analysis.
- Recent studies: depth resolved chemical analysis and imaging of easel paintings; analysis of the late use of smalt in paintings; PIXE analysis of early Egyptian glass from Amarna; in situ identification of prehistoric pigments in Palaeolithic caves (Rouffignac and Font-de-Gaume, Dordogne); non-invasive ion beam analysis of Palaeolithic mammoth ivory artefacts and their origin.



Friday, October 23, 2020 – 09:30 CET

## What's next in past landscapes studies? Drone-based platform a killer application in archaeological survey

Stefano Campana

*Università degli Studi di Siena, Italy*

### ABSTRACT

In the last decade new and progressively more sophisticated aerial platforms – UAVs or drones – have become widely available for archaeological applications traditionally carried out through the use of balloons, kites or light aircraft. More recently archaeologists have been testing both the drones and their sensors for the 3D recording of excavations, monuments and historic buildings as well as for the survey of whole archaeological sites and their landscape contexts. The scale and market expansion of these platforms has been driving the rapid development of both active and passive sensors specifically designed for UAVs. Today, drones are becoming more and more versatile through the creation of multiple devices that can undertake activities traditionally treated as either airborne (LiDAR) or ground-based (geophysical prospection). Drones are now available for 3D data capture in exploratory air photography and landscape survey, capable, with the aid of semi-automation and AI, of identifying and documenting surface scatters of archaeological material. High-resolution LiDAR survey, multispectral imaging and geophysical prospection by both radar and magnetometry can now be successfully undertaken through the use of drones – a real 'life-giver' in terms of archaeological technique. These advances promise to revolutionize the practice of archaeological survey as a whole.

### SPEAKERS BIOGRAPHY

**Stefano Campana** has been working for the past fifteen years at the University of Siena (Italy) and the University of Cambridge (UK). He is specializing in landscape archaeology, remote sensing and archaeological methodology for purposes of research, recording and conservation. His work is focused on the understanding of past landscapes from prehistory to the current age. The principal cultural context for his work has been Tuscany but he has also participated in and led research work in the UK, Spain, Turkey, Palestine, Iraq and Asia. Since 2006 he has been a faculty member of the University of Siena (Italy), in the Department of History and Cultural Heritage, where he has engaged in teaching and research as associate professor in Landscape Archaeology. From 2016 he has also been invited from the Department of Social, Political and Cognitive Sciences of the University of Siena to teach "Cultural Diplomacy and Archaeology" within the international master course in Cultural Diplomacy. From September 2014 to June 2016 he became Senior Research Fellow at the University of Cambridge (UK), Faculty of Classics.





He has established a sound reputation as an international authority in the field of landscape and digital archaeology. He promoted concepts such as 'emptyscapes' and the 'archaeological continuum' within rural studies and he have demonstrated their relevance to theoretical and practical approaches within Mediterranean archaeology, notably through the systematic application of large-scale geophysical survey, aerial exploration and air photography, including the use of drones and drone-based lidar.

In 2011 he was proposed and admitted as a Fellow of the Society of Antiquaries of London (FSA) and in 2012 he was invited to be a member of the General Management Board of HIST, the Governing Board of the International Centre on Space Technologies for Natural and Cultural Heritage, under the auspices of UNESCO and the Chinese Academy of Sciences. He was invited as visiting professor in 2014 at University of Lund, Department of Archaeology (Sweden), in 2016 at École Normale Supérieure (Paris), in 2017 at the Institute of Archaeology of Erbil (Erbil-Iraq) and in 20202 at the University of Bucharest, Faculty of History.

Saturday, October 24, 2020 – 09:30 CET

## Long-distance timber trading in the Roman Empire

Mauro Bernabei

*Università degli Studi di Siena, Italy*

### ABSTRACT

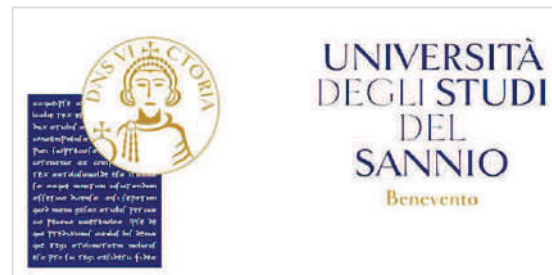
Throughout antiquity wood was the most important raw material and energy source. In contrast to other archaeological finds e.g. pottery, stone tools and metal, the in general poor preservation conditions for organic material make archaeological records of wood very rare. It is preserved over a long period of time only in very humid or very dry locations. Hence archaeological wooden remains are of particular interest for research: they provide insight into former environmental conditions, wood technology and ancient economic history. In addition yield annually resolved dendrochronological data that allows precise dating of archaeological features. During an archaeological excavation in the center of Rome 24 oak (*Quercus* sp.) planks were found as part of the foundation of a richly decorated portico, in a vast and wealthy property. Due to waterlogged conditions wood was remarkably well-preserved and the processing traces are still clearly visible. Most of the material belongs to a single lot of timber and shows no signs of reuse. Dendrochronological analyses were performed in order to date the structure. Further researches regarding the wood provenance were possible through statistical cross-dating. Our results demonstrated that the oak trees had been felled between 40 and 60 CE in the Jura Mountains of north-eastern France. It is most likely that the wood was transported to the Eternal City on the Saône and Rhône rivers and then across the Mediterranean Sea. This rare dendrochronological evidence from the capital of the Roman Empire gives fresh impetus to the ongoing debate on the likelihood of transporting timber over long distances within and between Roman provinces. This study reconstructs the administrative and logistic efforts required to transport high-quality construction timber from central Europe to Rome. It also highlights an advanced network of trade, and emphasises the enormous value of oak wood in Roman times.

### SPEAKERS BIOGRAPHY

- Degree in Forestry: 1993
- PhD in Wood Science: 1997
- Researcher at the National Research Council – Institute of BioEconomy (CNR-IBE) from 1998
- Head of the Laboratory of Dendrochronology of the CNR-IBE
- Research fields: wood science and all the aspects related to wood dating, conservation, species identification in archaeology, art history and cultural heritage.
- Recent studies: wood from Pompeii; olive trees from the Gethsemane garden in Jerusalem; the roof of the Basilica of Nativity in Bethlehem; the foundations of the Rialto Bridge in Venice; the Cherubini Collection musical instruments; the timber from historical buildings in Florence (Giotto's Bell Tower, Basilica of Santa Croce, Baptistry).



# MetroArchaeo 2020 Patronages





## Sponsored By



# CONFERENCE PROGRAM

---

## Technical Sessions - Thursday, October 22

---

### **SESSION 1.1 – SPECIAL SESSION ON MULTISCALE AND MULTITEMPORAL HIGH RESOLUTION REMOTE SENSING AND NON-DESTRUCTIVE TESTING FOR ARCHAEOLOGY AND MONUMENTAL HERITAGE: FROM RESEARCH TO PRESERVATION - PART 1**

**Room: Virtual Room #1**

**Chairs:** Giovanni Leucci, *ISPC - CNR, Italy*

Nicola Masini, *ISPC - CNR, Italy*

Salvatore Piro, *ISPC - CNR, Italy*

- 1 Integrated use of GPR and TDR for wood permittivity evaluation**  
*Filippo Comisi, University of Catania, Italy*  
*Lara De Giorgi, Institute of Cultural Heritage Sciences, CNR, Italy*  
*Giovanni Leucci, Institute of Cultural Heritage Sciences, CNR, Italy*
  
- 5 From causes to effects. Integration of heterogeneous data from non invasive imaging for the diagnosis and restoration of monuments. The case of the Church of S. Francesco della Scarpa in Lecce (Southern Italy)**  
*Giovanni Leucci, Institute of Cultural Heritage Sciences, CNR, Italy*  
*Francesco Gabellone, Nanotec CNR, Lecce, Italy*  
*Fabrizio Terenzio Gizzi, Institute of Cultural Heritage Sciences, CNR, Italy*  
*Nicola Masini, Institute of Cultural Heritage Sciences, CNR, Italy*
  
- 9 A multiscale research project, following an ancient decumanus in Montenegro**  
*Lucia Alberti, National Research Council of Italy, Italy*  
*Francesca Colosi, National Research Council of Italy, Italy*  
*Pasquale Merola, National Research Council of Italy, Italy*
  
- 15 Warscapes: A 'Submerged Information Basin'. The Contribution of LiDaR Data to the Unveiling**  
*Joel Aldrighettoni, University of Trento, Italy*  
*Alessandra Quendolo, University of Trento, Italy*
  
- 21 Acoustic remote sensing for seabed archaeology**  
*Crescenzo Violante, CNR, Italy*

---

### **SESSION 2.1 - SPECIAL SESSION ON GEOMATERIALS FOR CULTURAL HERITAGE - PART 1**

**Room: Virtual Room #2**

**Chairs:** Marco Lezzerini, *University of Pisa, Italy*

Stefano Pagnotta, *University of Pisa, Italy*

- 27 Evaluating the Effects of High Tide on Venetian Stone Buildings: A Multi Analytical Approach**  
*Gloria Zaccariello, Iuav University of Venice, Italy*  
*Elena Tesser, Iuav University of Venice, Italy*  
*Rebecca Piovesan, Iuav University of Venice, Italy*  
*Fabrizio Antonelli, Iuav University of Venice, Italy*
  
- 32 Petro-archaeometric characterization of historical mortars in the city of Ravenna (Italy)**  
*Elena Marrocchino, University of Ferrara, Italy*  
*Chiara Telloli, ENEA, Italy*  
*Paola Novara, National Museum of Ravenna, Italy*  
*Carmela Vaccaro, University of Ferrara, Italy*

- 38 **Thermal decay of monzogranite from Elba Island (western Tuscany, Italy): properties of an ancient building material**  
*Andrea Aquino, University of Pisa, Italy*  
*Michele Antola, University of Pisa, Italy*  
*Alessio Pacchini, University of Pisa, Italy*  
*Stefano Pagnotta, University of Pisa, Italy*  
*Marco Lezzerini, University of Pisa, Italy*
- 44 **Macigno sandstone from Garfagnana and Vellano (north-western Tuscany): chemical, mineralogical, petrographic and physical characterization of a building material**  
*Andrea Aquino, University of Pisa, Italy*  
*Claudio Di Petta, University of Pisa, Italy*  
*Stefano Pagnotta, University of Pisa, Italy*  
*Marco Tamponi, University of Pisa, Italy*  
*Marco Lezzerini, University of Pisa, Italy*
- 50 **Macigno sandstone from Monti d'Oltre Serchio: chemical, mineralogical, petrographic and physical characterization of a building material**  
*Andrea Aquino, University of Pisa, Italy*  
*Paolo Baglini, University of Pisa, Italy*  
*Stefano Pagnotta, University of Pisa, Italy*  
*Marco Tamponi, University of Pisa, Italy*  
*Marco Lezzerini, University of Pisa, Italy*
- 55 **Geopolymer mortar: metakaolin-based recipe for Cultural Heritage Application**  
*Stefano Pagnotta, University of Pisa, Italy*  
*Anna Lluveras Tenorio, University of Pisa, Italy*  
*Maria Rosaria Tinè, University of Pisa, Italy*  
*Marco Lezzerini, University of Pisa, Italy*

---

**SESSION 3.1 - SPECIAL SESSION ON INTEGRATED DIGITAL SURVEY METHODOLOGIES FOR THE KNOWLEDGE AND ENHANCEMENT OF ARCHITECTURAL AND URBAN HERITAGE-PART 1**

**Room: Virtual Room #3**

**Chairs:** Marco Giorgio Bevilacqua, *University of Pisa, Italy*

Assunta Pelliccio, *University of Cassino and Southern Latium, Italy*

- 60 **Rome: NE slopes of the Palatine hill. Analysis and quantification of ancient architectures**  
*Emanuele Brienza, Università degli Studi di Enna Kore, Italy*  
*Lorenzo Fornaciari, Università degli Studi di Salerno, Italy*
- 66 **Archives enhancement through design drawings survey, BIM modeling and prototyping**  
*Giulia Bertola, Politecnico di Torino, Italy*
- 72 **Baroque banded vaults with independent arches: from literature to realizations in Turin atria**  
*Fabrizio Natta, Politecnico di Torino, Italy*
- 78 **3D modelling trough planar slides, from digital to physical. Experiments on Palazzo Mazzonis' atrium in Turin**  
*Francesca Ronco, Politecnico di Torino, Italy*
- 84 **Archaeology of buildings and HBIM methodology: integrated tools for documentation and knowledge management of architectural heritage**  
*Ilaria Trizio, Italian National Research Council, Italy*  
*Francesca Savini, Italian National Research Council, Italy*
- 90 **Experiences of industrial archaeology in Italy: from survey to museum use**  
*Francesco Gabellone, National Research Council, Italy*

---

**POSTER SESSION 1**

**Room: Virtual Poster Room**

- 96 **The old scientific-technological instrumentations in the Museo dell' Arte della Lana of Stia**  
*Emma Angelini, Politecnico di Torino, Italy*  
*Andrea Gori, Museo dell'Arte della Lana, Italy*
- 101 **Mineralogical and chemical characterization of surface orange layers on the limestone of the Monastery of Batalha, Central Portugal**  
*Yufan Ding, University of Évora, Portugal, Polytechnic of Turin, Italy*  
*Pedro Redol, Mosteiro da Batalha, Portugal*  
*Emma Angelini, Polytechnic of Turin, Italy*  
*José Mirão, University of Évora, Portugal*  
*Nicola Schiavon, University of Évora, Portugal*
- 106 **Overview of structural health monitoring systems for the foundations of historic buildings**  
*Matilde Zarrella, University of Sannio, Italy*  
*Carmelo Scuro, University of Calabria, Italy*  
*Domenico Luca Carnì, University of Calabria, Italy*  
*Renato S. Olivito, University of Calabria, Italy*  
*Francesco Lamonaca, University of Sannio, Italy*
- 112 **Artificial Intelligence based monitoring system for historical building preservation**  
*Domenico Luca Carnì, University of Calabria, Italy*  
*Carmelo Scuro, University of Calabria, Italy*  
*Renato Sante Olivito, University of Calabria, Italy*  
*Maria Caterina Crocco, University of Calabria, Italy*  
*Francesco Lamonaca, University of Sannio, Italy*
- 117 **Full scale Dynamic Tests on Unreinforced and GFRMC reinforced Apulian Tuff Masonry Arches**  
*Anna Castellano, Polytechnic University of Bari, Italy*  
*Aguinaldo Fraddosio, Polytechnic University of Bari, Italy*  
*Jacopo Scacco, Politecnico di Milano, Italy*  
*Gabriele Milani, Politecnico di Milano, Italy*  
*Mario Daniele Piccioni, Polytechnic University of Bari, Italy*
- 123 **Dynamic Identification of the Damage for a Parabolic Tuff Barrel Vault with Differential Settlements of the Supports**  
*Anna Castellano, Polytechnic University of Bari, Italy*  
*Aguinaldo Fraddosio, Polytechnic University of Bari, Italy*  
*Jacopo Scacco, Politecnico di Milano, Italy*  
*Gabriele Milani, Politecnico di Milano, Italy*  
*Mario Daniele Piccioni, Polytechnic University of Bari, Italy*
- 129 **GPR prospecting for the search of St .Canio's lost bones (Acerenza, southern Italy)**  
*Lara De Giorgi, CNR ISPC, Italy*  
*Giovanni Leucci, CNR ISPC, Italy*  
*Maurizio Lazzari, CNR ISPC, Italy*  
*Raffaele Persico, Università della Calabria, Italy*
- 133 **A new methodological approach on the evaluation of stability of cavities in "soft" carbonate rocks.**  
*Lara De Giorgi, CNR ISPC, Italy*  
*Giovanni Leucci, CNR ISPC, Italy*
- 136 **3D GPR and ERT surveys at the coastal tower of S. Caterina (Lecce, Italy)**  
*Lara De Giorgi, Institute of Cultural Heritage Sciences, Italy*  
*Giancarlo De Pascalis, Università di Roma La Sapienza, Italy*  
*Ivan Ferrari, Institute of Cultural Heritage Sciences, Italy*  
*Francesco Giuri, Institute of Cultural Heritage Sciences, Italy*  
*Giovanni Leucci, Institute of Cultural Heritage Sciences, Italy*
- 140 **Geophysical surveys at the archaeological site of Anglona (Mt)**  
*Lara De Giorgi, CNR ISPC, Italy*  
*Dimitris Roubis, CNR, Italy*  
*Giovanni Leucci, CNR ISPC, Italy*

**144 Geometric survey and characterization of artifacts through portable devices: an experience of mobile laboratory inside the Aeolian Museum of Lipari**

*Dario Giuffrida, CNR-IPCF, Italy*

*Viviana Mollica Nardo, CNR-IPCF, Italy*

*Oreste Adinolfi, FARO Europe GmbH & Co., Germany*

*Maria Amalia Mastelloni, Parco Archeologico e Museo 'L. Bernabò Brea', Italy*

*Rosina Celeste Ponterio, CNR-IPCF, Italy*

**150 A database for historical pigments through handheld instrumentation**

*Giulia Festa, Centro Fermi, Italy*

*Claudia Scatigno, Centro Fermi, Italy*

*Maria Luisa Saladino, Università di Palermo, Italy*

*Francesco Armetta, Università di Palermo, Italy*

*Veronica Ciaramitaro, Università di Palermo, Italy*

*Viviana Mollica Nardo, CNR-IPCF, Italy*

*Rosina Celeste Ponterio, CNR-IPCF, Italy*

---

**SESSION 1.2 – SPECIAL SESSION ON MULTISCALE AND MULTITEMPORAL HIGH RESOLUTION REMOTE SENSING AND NON-DESTRUCTIVE TESTING FOR ARCHAEOLOGY AND MONUMENTAL HERITAGE: FROM RESEARCH TO PRESERVATION - PART 2**

**Room: Virtual Room #1**

**Chairs:** *Giovanni Leucci, ISPC - CNR, Italy*

*Nicola Masini, ISPC - CNR, Italy*

*Salvatore Piro, ISPC - CNR, Italy*

**155 Combined migration results in GPR prospecting**

*Raffaele Persico, University of Calabria, Italy*

*Gianfranco Morelli, Geostudi Astier Ltd, Italy*

**160 Spatial analysis and Lidar data for the extraction of archaeological features: the Etruscan site of San Giovenale, Blera (Lazio)**

*Maria Danese, CNR-ISPC, Italy*

*Rosa Lasaponara, CNR IMAA, Italy*

*Nicola Masini, CNR-ISPC, Italy*

**164 Multimethodological Geophysical Investigations to study the Archaeological Site of Norba (Norma, Central Italy)**

*Salvatore Piro, ISPC CNR, Italy*

*Stefania Quilici Gigli, Università della Campania Luigi Vanvitelli, Italy*

*Enrico Papale, ISPC CNR, Italy*

*Daniela Zamuner, ISPC CNR, Italy*

**168 Point clouds registration based on constant radius features for large and detailed cultural heritage objects**

*Luca Di Angelo, University of L'Aquila, Italy*

*Paolo Di Stefano, University of L'Aquila, Italy*

*Anna Eva Morabito, University of Salento, Italy*

*E. Guardiani, University of L'Aquila, Italy*

**174 Analysing the thermal conditions of historic buildings in Cyprus using archive Landsat satellite data and Google Earth Engine big data cloud platform**

*Athos Agapiou, Cyprus University of Technology, Eratosthenes Centre of Excellence, Cyprus*

*Vasiliki Lysandrou, Cyprus University of Technology, Eratosthenes Centre of Excellence, Cyprus*

*Diofantos Hadjimitsis, Cyprus University of Technology, Eratosthenes Centre of Excellence, Cyprus*

---

**SESSION 2.2 - SPECIAL SESSION ON GEOMATERIALS FOR CULTURAL HERITAGE - PART 1**

**Room: Virtual Room #2**

**Chairs:** *Marco Lezzerini, University of Pisa, Italy*

*Stefano Pagnotta, University of Pisa, Italy*



- 179 **The local black limestones used to make the typical black and white alternation of the Pisa's Romanesque Style**  
*Marco Lezzerini, University of Pisa, Italy*  
*Stefano Pagnotta, University of Pisa, Italy*  
*Andrea Aquino, University of Pisa, Italy*  
*Marcello Spampinato, University of Pisa, Italy*
- 184 **The role of 3D modelling for different stone objects: from mineral to artefact**  
*Andrea Aquino, University of Pisa, Italy*  
*Stefano Pagnotta, University of Pisa, Italy*  
*Elena Pecchioni, University of Florence, Italy*  
*Vanni Moggi Cecchi, University of Florence, Italy*  
*Stefano Columbu, University of Cagliari, Italy*  
*Marco Lezzerini, University of Florence, Italy*
- 189 **Workability and chemical physical degradation of limestone frequently used in historical Mediterranean architecture**  
*Stefano Columbu, University of Cagliari, Italy*  
*Paola Meloni, University of Cagliari, Italy*  
*Gianfranco Carcangiu, CNR, Istituto di Scienze dell'atmosfera e del Clima, Italy*  
*Dario Fancello, University of Cagliari, Italy*
- 196 **Ca-oxalate films on the stones of the medieval architecture: the case study of Romanesque Churches**  
*Stefano Columbu, University of Cagliari, Italy*  
*Marco Giamello, University of Siena, Italy*  
*Stefano Pagnotta, University of Pisa, Italy*  
*Andrea Aquino, University of Pisa, Italy*  
*Marco Lezzerini, University of Pisa, Italy*
- 202 **Cognitive methodology and diagnostic plan for cultural heritage conservation.**  
*Caterina Gattuso, University of Calabria, Italy*

---

**SESSION 3.2 - SPECIAL SESSION ON INTEGRATED DIGITAL SURVEY METHODOLOGIES FOR THE KNOWLEDGE AND ENHANCEMENT OF ARCHITECTURAL AND URBAN HERITAGE- PART 2**

**Room: Virtual Room #3**

**Chairs:** Marco Giorgio Bevilacqua, *University of Pisa, Italy*

Assunta Pelliccio, *University of Cassino and Southern Latium, Italy*

- 208 **Integrated digital survey for the knowledge and enhancement of the IIWW heritage. The Natural Park Molentargius-Saline (Cagliari, Italy)**  
*Andrea Pirinu, University of Cagliari, Italy*  
*Andrés Martínez-Medina, University of Alicante, Spain*  
*Nicola Paba, University of Cagliari, Italy*
- 214 **High performance laser survey and 3D stress analysis for maintenance and preservation of artistic assets**  
*Adriana Marra, Institute for Construction Technologies, CNR, Italy*  
*Salvatore Gerbino, University of Campania 'Luigi Vanvitelli', Italy*  
*Giovanni Fabbrocino, CNR, University of Molise, Italy*
- 220 **A parametric model to manage archaeological data**  
*Angela Bosco, Università degli Studi di Napoli L'Orientale, Italy*  
*Laura Carpentiero, Università degli Studi di Napoli L'Orientale, Italy*  
*Andrea D'Andrea, Università degli Studi di Napoli L'Orientale, Italy*  
*Eleonora Minucci, Università degli Studi di Napoli L'Orientale, Italy*  
*Rosario Valentini, Università degli Studi di Napoli L'Orientale, Italy*
- 226 **An assessment on morphological survey calibration and the automation of digital drawing for the reliable documentation and conservation analysis of out-of-scale buildings**  
*Raffaella De Marco, University of Pavia, Italy*  
*Alessia Miceli, University of Pavia, Italy*  
*Sandro Parrinello, University of Pavia, Italy*

232 **A digital twin for distant visit of inaccessible contexts**

*Francesco Gabellone*

---

**SESSION 1.3 – SPECIAL SESSION ON MULTISCALE AND MULTITEMPORAL HIGH RESOLUTION REMOTE SENSING AND NON-DESTRUCTIVE TESTING FOR ARCHAEOLOGY AND MONUMENTAL HERITAGE: FROM RESEARCH TO PRESERVATION - PART 3**

**Room: Virtual Room #1**

**Chairs:** Giovanni Leucci, *ISPC - CNR, Italy*

Nicola Masini, *ISPC - CNR, Italy*

Salvatore Piro, *ISPC - CNR, Italy*

238 **Urban Archaeo-Geophysics in Cusco. The Case Studies of Paraninfo and Casa Concha**

*Nicola Masini, CNR-ISPC, Italy*

*Sayri Garcia, Universidad Nacional de San Antonio Abad del Cusco, Peru*

*Maria Sileo, CNR-ISPC, Italy*

*Luigi Capozzoli, CNR-IMAA, Italy*

*David Vera, CNR-IMAA, Italy*

*Rosa Lasaponara, CNR-IMAA, Italy*

242 **The use of Cone Penetration Tests (CPT) for the study of the dynamic characteristics of the soils**

*Antonio Cavallaro, National Research Council - Institute of Heritage Science, Italy*

248 **Investigation of archaeological sites with species distribution models and satellite data**

*Noviello Mariangela, University of Bari 'Aldo Moro', Italy*

*Cafarelli Barbara, University of Foggia, Italy*

*Calculli Crescenza, University of Foggia, Italy*

*Sarris Apostolos, Foundation for Research & Technology, Greece*

*Mairota Paola, University of Bari 'Aldo Moro', Italy*

251 **Multianalytical investigation and 3D Multiband modeling: an integrated survey of the Garnier Valletti pomological collection**

*Emanuela Grifoni, University of Milan, Italy*

*Letizia Bonizzoni, University of Milan, Italy*

*Marco Gargano, University of Milan, Italy*

*Jacopo Melada, University of Milan, Italy*

*Ilaria Mignani, University of Milan, Italy*

*Nicola Ludwig, University of Milan, Italy*

---

**SESSION 2.3 - GENERAL SESSION - PART 1**

**Room: Virtual Room #2**

**Chairs:** Andrea Tavella, *LaBAAF, Università degli Studi di Trento, Italy*

Elisabetta Doria, *DICAr University of Pavia, Italy*

257 **Preliminary studies on the volumetric capacity of ceramic from the Neolithic site of Lugo di Grezzana (VR) through 3D graphics software**

*Andrea Tavella, LaBAAF, Università degli Studi di Trento, Italy*

*Marika Ciela, LaBAAF, Università degli Studi di Trento, Italy*

*Paolo Chistè, LaBAAF, Università degli Studi di Trento, Italy*

*Annaluisa Pedrotti, LaBAAF, Università degli Studi di Trento, Italy*

**263 Space & sound characterisation of small-scale architectural heritage: an interdisciplinary, lightweight workflow.**

*Jean-Yves Blaise, UMR CNRS/MC 3495 MAP 31, France*  
*Iwona Dudek, UMR CNRS/MC 3495 MAP 31, France*  
*Anthony Pamart, UMR CNRS/MC 3495 MAP 31, France*  
*Laurent Bergerot, UMR CNRS/MC 3495 MAP 31, France*  
*Adrien Vidal, Aix Marseille Univ, France*  
*Simon Fargeot, Aix Marseille Univ, France*  
*Mitsuko Aramaki, Aix Marseille Univ, France*  
*Solvi Ystad, Aix Marseille Univ, France*  
*Richard Kronland-Martinet, Aix Marseille Univ, France*

**269 Castiglioni Chapel in Pavia: a methodological approach for documentation and virtualisation techniques**

*Elisabetta Doria, DICAr University of Pavia, Italy*  
*Francesca Galasso, DICAr University of Pavia, Italy*  
*Marco Morandotti, DICAr University of Pavia, Italy*

**275 Measurements for the reconstruction of ancient walls in opus reticulatum in the basement of the castle of Santo Stefano in Puglia (Italy)**

*Angela Diceglie, Università degli Studi di Bari Aldo Moro, Italy*

---

**SESSION 3.3 - SPECIAL SESSION ON IoT BASED SYSTEMS FOR THE STRUCTURAL HEALTH MONITORING AND THE ANALYSIS OF CULTURAL HERITAGE BUILDING AND ARCHAEOLOGICAL SITES**

**Room: Virtual Room #3**

**Chairs:** Carmelo Scuro, *University of Calabria, Italy*  
Gabriele Milani, *Politecnico di Milano, Italy*

**281 Motion Magnification Analysis for monitoring Cultural heritage buildings and archeological sites**

*Sara Forliti, ENEA, Italy*  
*Vincenzo Fioriti, ENEA, Italy*  
*Ivan Roselli, ENEA, Italy*  
*Angelo Tati, ENEA, Italy*  
*Alessandro Colucci, ENEA, Italy*

**287 IoT-MHECHA: A new IoT architecture for Monitoring Health and Environmental parameters in Cultural Heritage and Archaeological sites.**

*Giuseppe Campobello, University of Messina, Italy*  
*Alessio Altadonna, University of Messina, Italy*  
*Fabio Todesco, University of Messina, Italy*  
*Nicola Donato, University of Messina, Italy*

**293 Settlement analysis of the masonry umbrella vault of the Masegra Castle**

*Nicola Grillanda, Politecnico di Milano, Italy*  
*Gabriele Milani, Politecnico di Milano, Italy*  
*Lorenzo Cantini, Politecnico di Milano, Italy*  
*Stefano Della Torre, Politecnico di Milano, Italy*

**298 A Novel Mathematical Structural Model Approach for Low Cost Structural Health Monitoring System**

*Carmelo Scuro, University of Calabria, Italy*  
*Saverio Porzio, University of Calabria, Italy*  
*Francesco Demarco, University of Calabria, Italy*  
*Domenico Luca Carnì, University of Calabria, Italy*  
*Francesco Lamonaca, University of Sannio, Italy*  
*Renato S. Olivito, University of Calabria, Italy*

---

## Technical Sessions - Friday, October 23

---

### **SESSION 1.4 – SPECIAL SESSION ON GEOMATICS AND CULTURAL HERITAGE: MODERN DIGITAL APPROACHES FOR SURVEYING AND DOCUMENTING THE PAST THROUGH GEOSPATIAL SOLUTIONS - PART 1**

**Room: Virtual Room #1**

**Chairs:** Gabriele Bitelli, *University of Bologna, Italy*

Maria Grazia D'Urso, *University of Bergamo, Italy*

**304 Digital reconstruction of a lost heritage: the San Geminiano's church in San Marco's Square in Venice**

*Caterina Balletti, Università Iuav di Venezia, Italy*

*Marcin Dabrowski, Università Iuav di Venezia, Italy*

*Francesco Guerra, Università Iuav di Venezia, Italy*

*Paolo Vernier, Università Iuav di Venezia, Italy*

**311 Preliminary data processing on the Roman Shipwreck of Grado. Archive and legacy data to create its 3D virtual model**

*Elisa Costa, Ca' Foscari University, Italy*

*Carlo Beltrame, Ca' Foscari University, Italy*

**316 BLK2GO for DTM generation in highly vegetated area for detecting and documenting archaeological earthwork anomalies**

*Marco Limongiello, University of Salerno, Italy*

*Diego Ronchi, Spiron Heritage and Survey, Italy*

*V. Albano, Leica Geosystems AG, Switzerland*

**322 Fostering Etruscan heritage with effective integration of UAV, TLS and SLAM based methods**

*Anna Rabbia, Politecnico di Torino, CRT - Fondazione Sviluppo e Crescita, Italy*

*Giulia Sammartano, Politecnico di Torino, FULL Polito, Italy*

*Antonia Spanò, Politecnico di Torino, FULL Polito, Italy*

---

### **SESSION 2.4 – SPECIAL SESSION ON THE INTERACTION BETWEEN ENVIRONMENTAL POLLUTION AND CULTURAL HERITAGE: FROM OUTDOOR TO INDOOR ENVIRONMENT - PART 1**

**Room: Virtual Room #2**

**Chairs:** Paola Fermo, *University of Milano, Italy*

Valeria Comite, *University of Milano, Italy*

**328 An experimental approach to the cleaning of a polymateric textile weave: set-up of the alternative methodology and instrumentation**

*Paola Fermo, Università degli Studi di Milano, Italy*

*Valeria Comite, Università degli Studi di Milano, Italy*

*Elisabetta Boanini, Fondazione Enaip Lombardia, Italy*

*Roberto Bonomi, Fondazione Enaip Lombardia, Italy*

*Marco Bertelli, A.L.M.A.G. S.p.A, Italy*

*Elisa Monfasani, Fondazione Enaip Lombardia, Italy*

**333 A new analytic methodology for the characterization of the carbonaceous fraction in black crusts present on stone surfaces**

*Valeria Comite, Università degli Studi di Milano, Italy*

*Mauro Francesco La Russa, (DiBEST), Università della Calabria, Italy*

*Paola Fermo, Università degli Studi di Milano, Italy*

**338 Air pollution, black crusts and Cairo monuments: a review**

*Rovella Natalia, (DiBEST), University of Calabria, Italy*

---

### **SESSION 3.4 – SPECIAL SESSION ON ARCHAEOMETRY FOR ARCHAEOLOGY: PROVENANCING AND TECHNOLOGICAL ASSESSMENT OF ARTIFACTS FROM ARCHAEOLOGICAL SITES AND MUSEUMS - PART 1**

**Room: Virtual Room #3**

**Chairs:** Fabrizio Antonelli, *University of IUAV of Venice, Italy*  
Lara Maritan, *University of Padova, Italy*

**343 Multi analytical study on Khol residues from the ancient Egyptian city of Assiut**

*Francesco Saliu, Università Milano Bicocca, Italy*  
*Chiara Riedo, University of Turin, Italy*  
*Dominique Scalarone, University of Turin, Italy*  
*Ilaria Degano, University of Pisa, Italy*  
*Francesca Modugno, University of Pisa, Italy*  
*Sergio Andò, Università Milano Bicocca, Italy*  
*Marco Orlandi, Università Milano Bicocca, Italy*  
*Oscar Chiantore, University of Turin, Italy*

**348 The contribution of Archaeometric Analyses to the Multi Disciplinary Research in Hierapolis of Phrygia, Turkey**

*Giulia Ricci, University of Padova, Italy*  
*Michele Secco, University of Padova, Italy*  
*Gilberto Artioli, University of Padova, Italy*  
*Fabio Marzaioli, Centre for Isotopic Research on Cultural and Environmental Heritage, Italy*  
*Isabella Passariello, Centre for Isotopic Research on Cultural and Environmental Heritage, Italy*  
*Filippo Terrasi, Centre for Isotopic Research on Cultural and Environmental Heritage, Italy*  
*Maria Rosa Valluzzi, University of Padova, Italy*

**354 Microscopic and chemical characterization of metal slags found at the Porta Paola excavation in Ferrara**

*Elena Marrocchino, University of Ferrara, Italy*  
*Chiara Telloli, ENEA, Italy*  
*Carmela Vaccaro, University of Ferrara, Italy*

---

**SESSION 1.5 – SPECIAL SESSION ON GEOMATICS AND CULTURAL HERITAGE: MODERN DIGITAL APPROACHES FOR SURVEYING AND DOCUMENTING THE PAST THROUGH GEOSPATIAL SOLUTIONS - PART 2**

**Room: Virtual Room #1**

**Chairs:** Gabriele Bitelli, *University of Bologna, Italy*  
Maria Grazia D’Urso, *University of Bergamo, Italy*

**360 Integrated geomatic methodologies to reconstruct the ancient topography of Rome**

*Luca Alessandri, Groningen University, The Netherland*  
*Valerio Baiocchi, Sapienza University of Rome, Italy*  
*Marta Baumgartner, Soprintendenza Speciale di Roma, Italy*  
*Diego Blanco, Archeogeos, Italy*  
*Alessandro Bosman, CNR IGAG, Italy*  
*Luigi Cardone, Sapienza University of Rome, Italy*  
*Andrea Guaglianone, Italy*  
*Matteo Onori, Sapienza University of Rome, Italy*  
*Felicia Vatore, Sapienza University of Rome, Italy*

**366 Geomatics as a knowledge base propaedeutic to the restoration of an extended fresco wall**

*Gabriele Bitelli, Alma Mater Studiorum Università di Bologna, Italy*  
*Valentina Alena Girelli, Alma Mater Studiorum Università di Bologna, Italy*  
*Giulia Vannucci, Alma Mater Studiorum Università di Bologna, Italy*  
*Emanuele Mandanici, Alma Mater Studiorum Università di Bologna, Italy*  
*Marinella Pigozzi, Alma Mater Studiorum Università di Bologna, Italy*

**372 Survey and preservation of an abandoned archaeological industrial site**

*Maria Grazia D’Urso, University of Bergamo, Italy*  
*Valerio Manzari, University of Cassino and Southern Lazio, Italy*  
*Francesco Cavaliere, Italy*  
*Barbara Marana, University of Bergamo, Italy*  
*Francesco Marmo, University of Naples Federico II, Italy*

---

## **SESSION 2.5 – SPECIAL SESSION ON NEUTRON TECHNIQUES IN ARCHEOMETRY**

**Room: Virtual Room #2**

**Chairs:** Francesco Grazzi, CNR, Italy

Marco Zanatta, University of Trento, Italy

**378 Reconstruction of 3D models from microtomographic images of archeological artifacts**

*Enej Gucek Puhar, University of Ljubljana, Slovenia*

*Lidija Korat, Slovenian National Building and Civil Engineering Institute, Slovenia*

*Miran Eric, Institute for the Protection of Cultural Heritage, Slovenia*

*Ales Jaklic, University of Ljubljana, Slovenia*

*Franc Solina, University of Ljubljana, Slovenia*

**384 Preliminary Alloys Characterization and Technological Interpretation of the Manufacturing Process of the Vittoria Alata di Brescia by means of Neutron Diffraction**

*Francesco Cantini, MIBACT Opificio delle Pietre Dure, Italy*

*M. Galeotti, MIBACT Opificio delle Pietre Dure, Italy*

*A. Cagnini, MIBACT Opificio delle Pietre Dure, Italy*

*S. Porcinai, MIBACT Opificio delle Pietre Dure, Italy*

*Antonella Scherillo, ISIS Neutron and Muon Source, United Kingdom*

*A. Brini, MIBACT Opificio delle Pietre Dure, Italy*

*A. Patera, MIBACT Opificio delle Pietre Dure, Italy*

*F. Morandini, Fondazione Brescia Musei, Italy*

*F. Grazzi, CNR, INFN, Italy*

**389 Neutron-based techniques applied for non-destructive quantitative characterisation of ancient mosaic tesserae**

*Giulia Marcucci, University of Milano Bicocca, INFN, Italy*

*Antonella Scherillo, ISIS Neutron and Muon Source, United Kingdom*

*Carlo Cazzaniga, ISIS Neutron and Muon Source, United Kingdom*

*Massimiliano Clemenza, University of Milano Bicocca, INFN, Italy*

*Daniela Di Martino, University of Milano Bicocca, INFN, Italy*

**394 Preliminary result of investigation of element composition of Kyathos (6th-4th centuries BCE) from the necropolis Volna 1 on the Taman Peninsula by Neutron Resonance Capture Analysis**

*Nina V. Simbirtseva, Joint Institute for Nuclear Research, Russia, Institute of Nuclear Physics, Republic of Kazakhstan*

*Pavel V. Sedyshev, Joint Institute for Nuclear Research, Russia*

*Saltanat T. Mazhen, Joint Institute for Nuclear Research, Russia, Institute of Nuclear Physics, Republic of Kazakhstan*

*Almat M. Yergashov, Joint Institute for Nuclear Research, Russia, Institute of Nuclear Physics, Republic of Kazakhstan*

*Irina A. Saprykina, Institute of Archaeology of the Russian Academy of Sciences, Russia*

*Roman A. Mimokhod, Institute of Archaeology of the Russian Academy of Sciences, Russia*

**399 Non-invasive characterization of Nuragic bronzes through neutron based techniques**

*Matteo Cataldo, Università degli Studi di Sassari, Italy*

*F. Grazzi, CNR, Istituto di Fisica Applicata 'Nello Carrara', Italy*

*Antonella Scherillo, ISIS Neutron Source, United Kingdom*

*A. Fedrigo, ISIS Neutron Source, United Kingdom*

*A. Depalmas, Università degli Studi di Sassari, Italy*

*A. Canu, Soprintendenza Archeologia, Belle Arti e Paesaggio per le province di Sassari e Nuoro, Italy*

*A. Brunetti, Università degli Studi di Sassari, Italy*

---

## **SESSION 3.5 – SPECIAL SESSION ON ARCHAEOOMETRY FOR ARCHAEOLOGY: PROVENANCING AND TECHNOLOGICAL ASSESSMENT OF ARTIFACTS FROM ARCHAEOLOGICAL SITES AND MUSEUMS - PART 2**

**Room: Virtual Room #3**

**Chairs:** Fabrizio Antonelli, University of IUAV of Venice, Italy

Lara Maritan, University of Padova, Italy

- 404 **Archaeology and archaeometry of marbles in Roman central Adriatic Italy**  
*Devi Taelman, Ghent University, Belgium*  
*Dimitri Van Limbergen, Ghent University, Belgium*  
*Fabrizio Antonelli, IUAV University of Venice, Italy*
- 410 **Analytical data on marble sculptures' polychrome traces (Palatine hill, Rome)**  
*Maria Cristina Caggiani, University of Catania, Italy*  
*Alessia Coccato, University of Catania, Italy*  
*Silvia Borghini, Museo Nazionale Romano, Italy*  
*Paolo Mazzoleni, University of Catania, Italy*  
*Alfonsina Russo, Parco Archeologico del Colosseo, Italy*  
*Germana Barone, University of Catania, Italy*
- 415 **Colorimetric Study of Ayla-Aksum amphorae from the Red Sea Coast of Eritrea**  
*Abraham Zerai, Università di Torino, INFN, Italy*  
*Patrizia Davit, Università di Torino, Italy*  
*Monica Gulmini, Università di Torino, Italy*  
*Alessandro Re, Università di Torino, INFN, Italy*  
*Roberto Giustetto, Università di Torino, INFN, Italy*  
*Lara Maritan, Università di Padova, Italy*  
*Serena Massa, Università Cattolica del Sacro Cuore, Italy*  
*Chiara Mandelli, Università Cattolica del Sacro Cuore, Italy*  
*Yohannes Gebreyesus, Northern Red Sea Regional Museum of Massawa, Eritrea*  
*Alessandro Lo Giudice, Università di Torino, INFN, Italy*
- 

## **POSTER SESSION 2**

**Room: Virtual Poster Room**

- 420 **Project of Electronic Identity of painting**  
*Giuseppe Schirripa Spagnolo, Università degli Studi Roma Tre, Italy*  
*Lorenzo Cozzella, Università degli Studi Roma Tre, Italy*  
*Fabio Leccese, Università degli Studi Roma Tre, Italy*
- 425 **The coloured stones and marbles decorating the Odeion of Pompeii**  
*Fabrizio Antonelli, Iuav University of Venice, Italy*  
*Lorenzo Lazzarini, Iuav University of Venice, Italy*  
*Stefano Cancelliere, Iuav University of Venice, Italy*  
*Luigi Buffone, Applied research laboratory of the Archaeological Park of Pompeii, Italy*
- 431 **DAMAGE assessment of cultural stone heritage in reservoir environments**  
*Monica Alvarez de Buergo, IGEO (CSIC, UCM), Spain*  
*Natalia Perez Ema, IGEO (CSIC, UCM), Spain*  
*Rafael Fort, IGEO (CSIC, UCM), Spain*  
*Manuel Garcia Rodriguez, Universidad de Educacion a Distancia UNED, Spain*  
*María J. Varas, IGEO (CSIC, UCM), Spain*  
*Mauro Francesco La Russa, Università della Calabria, Italy*
- 435 **A preliminary study on black crusts from the Monumental Cemetery of Milan**  
*Valeria Comite, Università degli studi di Milano, Italy*  
*Donatella Bonelli, Scuola di Restauro 'Arrigo Boito' Italy*  
*Paola Fermo, Scuola di Restauro 'Arrigo Boito' Italy*
- 440 **Coratelli Mill: micro-geophysical investigations for structural diagnostics**  
*Lara De Giorgi, CNR ISPC, Italy*  
*Giovanni Leucci, CNR ISPC, Italy*

- 444 **Geophysical investigations at the Cathedral of Catania**  
*Giovanni Leucci, CNR ISPC, Italy*  
*Lara De Giorgi, CNR ISPC, Italy*  
*Giovanni Fragalá, CNR, Italy*  
*Antonino Mazzaglia, CNR, Italy*  
*Daniele Malfitana, CNR, Italy*
- 448 **GIS for the cataloging and enhancement of "specchie" located in the Upper Salento in Apulia Region (Southern Italy)**  
*Maurizio Delli Santi, ISPC-CNR, Italy*
- 453 **Geophysical investigations, digital reconstruction and numerical modeling at the Batia Church in Tortorici (Messina, Sicily): preliminary results**  
*Sebastiano D'Amico, University of Malta, Malta*  
*Emanuele Colica, University of Malta, Malta*  
*Raffaele Persico, Università della Calabria, Italy*  
*Michele Betti, University of Florence, Italy*  
*Salvatore Foti, Studio di Ingegneria, Associazione Centro di Storia Patria dei Nebrodi, Italy*  
*Maurizio Paterniti Barbino, Studio Geom. Maurizio Paterniti Barbino*  
*Luciano Galone, University of Malta, Malta*
- 457 **Preliminary geophysical surveys and archaeological studies into the buried urban plan of the Lucanian settlement of Caselle in Pittari**  
*Luigi Capozzoli, CNR- IMAA, Italy*  
*Gregory De Martino, CNR- IMAA, Italy*  
*Vincenzo Lapenna, CNR- IMAA, Italy*  
*Felice Perciante, CNR- IMAA, Italy*  
*Enzo Rizzo, CNR- IMAA, University of Ferrara, Italy*  
*Maria Luigia Rizzo, Università degli Studi di Salerno, Italy*  
*Antonia Serritella, Università degli Studi di Salerno, Italy*  
*Michele Scafuro, Università degli Studi di Salerno, Italy*  
*Ottavia Voza, Università degli Studi di Salerno, Italy*
- 461 **Preliminary study for the preservation of two natural horns from the end of the 17th century**  
*Michela Albano, CISRiC, University of Pavia, Politecnico di Milano, Italy*  
*Giacomo Fiocco, CISRiC, University of Pavia, University of Turin, Italy*  
*Piercarlo Dondi, CISRiC, University of Pavia, Italy*  
*Francesca Tasso, Castello Sforzesco, Italy*  
*Valentina Ricetti, Castello Sforzesco, Italy*  
*Daniela Comelli, Politecnico di Milano, Italy*  
*Maurizio Licchelli, University of Pavia, Italy*  
*Claudio Canevari, University of Pavia*  
*Marco Malagodi, CISRiC, University of Pavia, Italy*
- 467 **Towards the study of alteration patinas on the marble surface of a Renaissance sculptural group from the Museum of Ancient Art (Castello Sforzesco, Milan)**  
*Valeria Comite, Università degli Studi di Milano, Italy*  
*Mario Colella, Università degli Studi di Milano, Piccolo chiostro s.r.l., Italy*  
*Marco Malagodi, CISRiC, University of Pavia, Italy*  
*Giacomo Fiocco, CISRiC, University of Pavia, Università di Torino, Italy*  
*Michela Albano, University of Pavia, Polytechnic of Milan, Italy*  
*Silvia Marchioron, Piccolo chiostro s.r.l., Italy*  
*Paola Fermo, Università degli Studi di Milano, Italy*
- 472 **Environmental impact on historical monuments: the black crusts of the Venice lagoon**  
*Luciana Randazzo, DiBEST, Italy*  
*Natalia Rovella, DiBEST, Italy*  
*Silvia Muto, DiBEST, Italy*  
*Fabrizio Antonelli, University Iuav di Venezia, Italy*  
*Elena Tesser, University Ca' Foscari, Venice, Italy*  
*Mauro Francesco La Russa, DiBEST, Italy*



- 477 **Frescoed wall conditions assessment with noninvasive GPR survey: the case of the Crypt of San Francesco in Irsina (Basilicata, Southern Italy)**  
*Luigi Capozzoli, CNR-IMAA, Italy*  
*M.P. Boccia*  
*Gregori De Martino, CNR-IMAA, Italy*  
*Fabrizio Terenzio Gizzi, CNR-ISPC, Italy*  
*Maria Sileo, CNR-ISPC, Italy*  
*Nicola Masini, CNR-ISPC, Italy*
- 481 **L'Avventuroso 1936 project: the first analytical approach to printed historic Italian comics**  
*Giacomo Fiocco, Università degli Studi di Pavia, Università di Torino, Italy*  
*Tommaso Rovetta, Università degli Studi di Pavia, Italy*  
*Michela Albano, Università degli Studi di Pavia, Politecnico di Milano, Italy*  
*Mario A. Lazzari, Scuola di Restauro Cr.Forma, Italy*  
*Curzio Merlo, Università degli Studi di Pavia, Scuola di Restauro Cr.Forma, Italy*  
*Marco Malagodi, Università degli Studi di Pavia, Italy*
- 486 **Aerosol tracers deposition in a controlled field experiment: role of surface building materials**  
*Pierina Ielpo, National Research Council, Italy*  
*Patrick Conry, University of Notre Dame, USA*  
*Alessandra Genga, University of Salento, Italy*  
*Riccardo Buccolieri, University of Salento, Italy*  
*Livia Giotta, University of Salento, Italy*  
*Francesca Di Nicola, University of Salento, Italy*  
*Maria Lisa Vincenti, University of Salento, Italy*  
*Ludovico Valli, University of Salento, Italy*  
*H. J. S. Fernando, University of Notre Dame, USA*  
*Silvana Di Sabatino, University of Bologna, Italy*

---

## **SESSION 1.6 – SPECIAL SESSION ON HANDHELD AND MOBILE INSTRUMENTATION IN CULTURAL HERITAGE RESEARCH**

### **Room: Virtual Room #1**

**Chairs:** Rosina Celeste Ponterio, *CNR, Italy*

*Giulia Festa, Centro Fermi, Italy*

*Maria Luisa Saladino, University of Palermo, Italy*

*Viviana Mollica Nardo, CNR, Italy*

- 491 **A multidisciplinary approach about study of Orgères's metal finds (La Thuile, Aosta-Italy): archaeological excavation and XRF analysis.**

*Chiara Maria Lebole, University of Torino, Italy*

*Greta Lupano, University of Torino, Italy*

*Sylvie Cheney, Autonomous Region of Valle d'Aosta, Italy*

*Giorgio Di Gangi, University of Torino, Italy*

- 496 **Modular MA-XRF scanner potentialities and further advances**

*Sergio Augusto Barcellos Lins, La Sapienza Università di Roma, INFN Roma Tre, Italy*

*Marta Manso, Universidade Nova de Lisboa, Portugal*

*Giovanni Ettore Gigante, La Sapienza Università di Roma, Italy*

*Roberto Cesareo, Università degli Studi di Sassari, Italy*

*Luca Tortora, INFN Roma Tre, Italy*

*Paolo Branchini, INFN Roma Tre, Italy*

*Stefano Ridolfi, Università degli Studi di Sassari, Italy*

- 501 **Non destructive spectroscopic methods for gem analysis: a short review**

*Simona Raneri, ICCOM CNR, Italy*

*Germana Barone, University of Catania, Italy*

*Paolo Mazzoleni, University of Catania, Italy*

*Danilo Bersani, University of Parma, Italy*

**507 INFN-CHNet meets CCR La Venaria Reale: first results**

*Leandro Sottili, Università degli Studi di Torino, INFN, Italy*  
*Laura Guidorzi, Università degli Studi di Torino, INFN, Italy*  
*Anna Mazzinghi, INFN, Università degli Studi di Firenze, Italy*  
*Chiara Ruberto, INFN, Università degli Studi di Firenze, Italy*  
*Lisa Castelli, INFN, Italy*  
*Caroline Czelusniak, INFN, Italy*  
*Lorenzo Giuntini, INFN, Università degli Studi di Firenze, Italy*  
*Mirko Massi, INFN, Italy*  
*Francesco Taccetti, INFN, Italy*  
*Marco Nervo, INFN, 'La Venaria Reale', Italy*  
*Alessandro Re, Università degli Studi di Torino, INFN, Italy*  
*Alessandro Lo Giudice, Università degli Studi di Torino, INFN, Italy*

**512 Imaging for Cultural Heritage and Archaeology**

*Paolo Triolo, University of Genova and University of Urbino, Italy*  
*Luciano Marras, Art-Test Studio di Luciano Marras, Italy*  
*Gloria Adinolfi, Società Pegaso, Italy*  
*Rodolfo Carmagnola, Società Pegaso, Italy*  
*S. Legnaioli, ICCOM-CNR, Italy*  
*Simona Raneri, ICCOM-CNR, Italy*  
*V. Palleschi, ICCOM-CNR, Italy*

**517 Santa Maria del Fiore Cupola construction tools: a non-invasive characterization using portable XRF**

*Leila Es Sebar, Politecnico di Torino, Italy*  
*Leonardo Iannucci, Politecnico di Torino, Italy*  
*Sabrina Grassini, Politecnico di Torino, Italy*  
*Emma Angelini, Politecnico di Torino, Italy*  
*Marco Parvis, Politecnico di Torino, Italy*  
*Andrea Bernardoni, Museo Galileo, Italy*  
*Alexander Neuwahl, Artes Mechanicae, Italy*  
*Rita Filardi, Museo dell'Opera del Duomo, Italy*

---

**SESSION 2.6 – SPECIAL SESSION ON DAMAGE ASSESSMENT: DIAGNOSIS AND MONITORING FOR THE RESTORATION, PREVENTIVE CONSERVATION AND MAINTENANCE OF CH**

**Room: Virtual Room #2**

**Chairs:** *Giuseppe Paladini, University of Messina, Italy*  
*Luciana Randazzo, University of Calabria, Italy*  
*Natalia Rovella, University of Calabria, Italy*

**522 Ancient bricks technologies: improving the built heritage conservation at high humidity areas**

*Elena Pérez Monserrat, University of Padua, Italy*  
*Lara Maritan, University of Padua, Italy*  
*Marie Ange Causarano, University of Padua, Italy*  
*Alejandra Chavarría, University of Padua, Italy*  
*Gian Pietro Brogiolo, University of Padua, Italy*

**527 Polydimethylsiloxane (PDMS) /ZrO<sub>2</sub> doped ZnO nanocomposites as protective coatings for stone materials**

*Maduka L. Weththimuni, Università di Pavia, Italy*  
*Marwa Ben Chobba, University of Sfax, Tunisia*  
*Ilenia Tredici, Università di Pavia, Italy*  
*Maurizio Licchelli, Università di Pavia, Italy*

**532 Digital reconstruction and scientific analysis prior the restoration of two paintings by Mattia Preti in the Church of the Immaculate Conception of Sarria (Floriana, Malta)**

*Sebastiano D'Amico, University of Malta, Malta*

*Valentina Venuti, University of Messina, Italy*

*Emanuele Colica, University of Malta, Malta*

*Giuseppe Paladini, University of Messina, Italy*

*Luciano Galone, University of Malta, Malta*

*Vincenza Crupi, University of Messina, Italy*

*Domenico Majolino, University of Messina, Italy*

*Sante Guido, University of Trento, Italy*

*Giuseppe Mantella, Restauro Opere D'Arte, Italy*

**538 The three polychrome mosaics of S. Aloe quarter in Vibo Valentia (Calabria, Southern Italy): chemical characterization of glass tesserae**

*Natalia Rovella, University of Calabria, Italy*

*Elia Fiorenza, University of Calabria, Italy*

*Donatella Barca, University of Calabria, Italy*

**543 The role of geosciences and non destructive methods in the TECTONIC project**

*Michela Ricca, University of Calabria, Italy*

*Marco Ricci, University of Calabria, Italy*

*Stefano Laureti, University of Calabria, Italy*

*Mauro Francesco La Russa, University of Calabria, Italy*

---

**SESSION 3.6 – SPECIAL SESSION ON ARCHAEOOMETRY FOR ARCHAEOLOGY: PROVENANCING AND TECHNOLOGICAL ASSESSMENT OF ARTIFACTS FROM ARCHAEOLOGICAL SITES AND MUSEUMS - PART 3**

**Room: Virtual Room #3**

**Chairs:** Fabrizio Antonelli, *University of IUAV of Venice, Italy*

Lara Maritan, *University of Padova, Italy*

**548 A multi-analytical survey for the identification of the red and yellow pigments of coloured sherds discovered in the Monte d'Oro area (Rome).**

*Vittoria Guglielmi, Università degli Studi di Milano, Italy*

*Paola Fermo, Università degli Studi di Milano, Italy*

*Martina Andreoli, University of Trento, Italy*

*Valeria Comite, Università degli Studi di Milano, Italy*

**554 The pottery production at Sumhuram (Khor Rori, Sultanate of Oman): an archaeometric study**

*Stefano Pagnotta, University of Pisa, Italy*

*Giulia Buono, University of Pisa, Italy*

*Marco Lezzerini, University of Pisa, Italy*

*Alexia Pavan, Ministry of Heritage and Tourism, Muscat Salalah, Sultanate of Oman*

*Carlotta Rizzo, University of Pisa, Italy*

**559 Petrographic analysis to understand Etruscan architectural terracotta's technology and provenance: a study in progress.**

*Maura Fugazzotto, University of Catania, Italy*

*Antonio Strocchio, University of Catania, Italy*

*Antonella Bertino, University of Catania, Italy*

*Germana Barone, University of Catania, Italy*

*Alfonsina Russo, Parco Archeologico del Colosseo, Italy*

*Paolo Mazzoleni, University of Catania, Italy*

**564 Thermoluminescence dating and microstructural characterization of archaeological ceramic samples from Corvins' Castle area**

*Rodica-Mariana Ion, ICECHIM, Group, Valahia University, Romania*  
*Radu Setnescu, INCDIE ICPE-CA, Valahia University of Targoviste, Romania*  
*Tanta Setnescu, Valahia University of Targoviste, Romania*  
*Anca Irina Gheboianu, Valahia University of Targoviste, Romania*  
*Gabriel Vasilievici, ICECHIM, Group, Romania*  
*Sorin Tincu, Corvins' Castle, Romania*

---

**Technical Sessions - Saturday, October 24**

---

**SESSION 1.7 – GENERAL SESSION - PART 2**

**Room: Virtual Room #1**

**Chairs:** Mauro Bernabei, *CNR IBE, Italy*  
Nicoletta Martinelli, *Laboratorio Dendrodata, Italy*

**570 Effect of age on Pine wood microstructure studied by micro-MRI and diffusion-NMR**

*Valeria Stagno, Sapienza University of Rome, National Research Council, Italy*  
*Sveva Longo, National Research Council, University of Messina, Italy*  
*Silvia Capuani, National Research Council, Italy*

**575 Multicentennial regional oak chronologies for northern Italy: an updating**

*Nicoletta Martinelli, Laboratorio Dendrodata, Italy*

**579 The tree species of Po valley Logboats**

*Alice Lucchini, Università Ca Foscari di Venezia, Italy*  
*Mauro Bernabei, CNR IBE, Italy*

**585 Characterization of Etruscan non vascular ceramic fragments**

*Margherita Cantelli, Ca' Foscari University of Venice, Italy*  
*Alberta Facchi, Ministry of Cultural Heritage and Activities*  
*Francesca C. Izzo, Ca' Foscari University of Venice, Italy*  
*Elisabetta Zendri, Ca' Foscari University of Venice, Italy*

**590 May metagenomics disclose the hidden secrets of the ancient damaged parchments?**

*Luciana Migliore, Tor Vergata University, Italy*  
*Nicoletta Perini, Tor Vergata University, Italy*  
*Annamaria Alabiso, Tor Vergata University, Italy*

---

**SESSION 2.7 – GENERAL SESSION - PART 3**

**Room: Virtual Room #2**

**Chairs:** Ilaria Patania, *University of Haifa, Israel*  
Omar Larentis, *University of Insubria, Italy*  
Fabio Santaniello, *University of Trento, Italy*

**594 Distinguishing colour alteration processes occurred in Late Pleistocene animal remains**

*Andrea Perez, University of Trento, Italy*  
*Fabio Santaniello, University of Trento, Italy*  
*Stefano Grimaldi, University of Trento, Italy*  
*Stefano Gialanella, University of Trento, Italy*

- 600 Differences between archaeological and forensic burned samples using powder X-ray diffraction (XRD) and ATR-IR spectrometry**  
*Giampaolo Piga, University of Coimbra, Portugal*  
*Fabio Cavalli, Julian-Isontine University Integrated Health Enterprise (ASUGI), Italy*  
*Dario Innocenti, Julian-Isontine University Integrated Health Enterprise (ASUGI), Italy*  
*Eugénia Cunha, University of Coimbra, Portugal*  
*Stefano Enzo, University of Sassari, Italy*  
*David Gonçalves, University of Coimbra, Portugal, Archaeosciences Laboratory, Spain*
- 605 The Roman bridge of Canosa di Puglia: a metrological approach**  
*Germano Germanò, Polytechnic University of Bari, Italy*
- 611 Optical micro-profilometry for surface analysis and 3D printed replica of archeological artefacts**  
*Sara Mazzocato, University of Verona, Italy*  
*Giacomo Marchioro, University of Verona, Italy*  
*Alessandra Menegazzi, University of Padua, Italy*  
*Claudia Daffara, University of Verona, Italy*
- 617 Operational methodology for a historical, critical and virtual reconstruction of Baroque ephemeral apparatuses**  
*Margherita Antolini*
- 623 Upgrade of the x-ray imaging set-up at CCR "La Venaria Reale": the case study of an Egyptian wooden statuette**  
*Luisa Vigorelli, Politecnico di Torino, Università degli Studi di Torino, INFN, Italy*  
*Alessandro Lo Giudice, Università degli Studi di Torino, INFN, Italy*  
*Tiziana Cavaleri, Centro Conservazione e Restauro 'La Venaria Reale', Italy*  
*Paola Buscaglia, Centro Conservazione e Restauro 'La Venaria Reale', Italy*  
*Marco Nervo, INFN, Centro Conservazione e Restauro 'La Venaria Reale', Italy*  
*Paolo Del Vesco, Fondazione Museo delle Antichità Egizie di Torino, Italy*  
*Matilde Borla, Soprintendenza ABAP-TO, Italy*  
*Sabrina Grassini, Politecnico di Torino, Italy*  
*Alessandro Re, Università degli Studi di Torino, INFN, Italy*

---

**SESSION 3.7 – SPECIAL SESSION ON THE INTERACTION BETWEEN ENVIRONMENTAL POLLUTION AND CULTURAL HERITAGE: FROM OUTDOOR TO INDOOR ENVIRONMENT - PART 2**

**Room: Virtual Room #3**

**Chairs:** *Paola Fermo, University of Milano, Italy*  
*Valeria Comite, University of Milano, Italy*

- 629 An Innovative Fluorinated Polyacrylic Coating for the Protection of the Cultural Heritage**  
*Eleonora Pargoletti, Università degli Studi di Milano, Consorzio INSTM, Italy*  
*Valeria Comite, Università degli Studi di Milano, Consorzio INSTM, Italy*  
*Valentina Sabatini, Università degli Studi di Milano, Italy*  
*Paola Fermo, Università degli Studi di Milano, Consorzio INSTM, Italy*  
*Marco Aldo Orteni, Università degli Studi di Milano, Italy*  
*Hermes Farina, Università degli Studi di Milano, Italy*  
*Giuseppe Cappelletti, Università degli Studi di Milano, Consorzio INSTM, Italy*
- 635 Correlation of indoor air quality and stable carbon isotope ratio of CO<sub>2</sub> in historical monuments of Italy: a case study**  
*Concetta Pironti, University of Salerno, Italy*  
*Maria Ricciardi, University of Salerno, Italy*  
*Antonio Proto, University of Salerno, Italy*  
*Raffaele Cucciniello, University of Salerno, Italy*  
*Antonino Fiorentino, University of Salerno, Italy*  
*Oriana Motta, University of Salerno, Italy*

**641 Black crusts grown on varied stone substrata from historical buildings under different air quality scenarios (SE and NW Spain)**

*José Santiago Pozo-Antonio, Universidade de Enxeñaría de Minas e Enerxía, Spain*

*Carolina Cardell, University of Granada, Spain*

*Valeria Comite, Università degli Studi di Milano, Italy*

*Paola Fermo, Università degli Studi di Milano, Italy*

**646 Chemical and isotopic investigations on the deterioration of the Monumental Complex of S. Pietro in Corte in Salerno (Italy) caused by the rising waters**

*Maria Ricciardi, University of Salerno, Italy*

*Concetta Pironti, University of Salerno, Italy*

*Oriana Motta, University of Salerno, Italy*

*Rosa Fiorillo, University of Salerno, Italy*

*Federica Camin, Fondazione Edmund Mach, University of Trento, Italy*

*Antonio Proto, University of Salerno, Italy*

**651 Indoor air quality monitoring with stable carbon isotope ratio of CO<sub>2</sub> in Museum Environments: study for the Leonardo da Vinci's 'Last Supper'**

*Oriana Motta, University of Salerno, Italy*

*Concetta Pironti, University of Salerno, Italy*

*Maria Ricciardi, University of Salerno, Italy*

*Ezio Bolzacchini, University of Milano-Bicocca, Italy*

*Luca Ferrero, University of Milano-Bicocca, Italy*

*Chiara Rostagno, Direzione Regionale Museale Regionale della Lombardia, Italy*

*Raffaele Cucciniello, University of Salerno, Italy*

*Antonio Proto, University of Salerno, Italy*

**657 Index of Authors**

# Integrated digital survey for the knowledge and enhancement of the IIWW heritage. The Natural Park *Molentargius-Saline* (Cagliari, Italy)

Andrea Pirinu<sup>1</sup>, Andrés Martínez-Medina<sup>2</sup>, Nicola Paba<sup>3</sup>

<sup>1</sup> *University of Cagliari DICAAR,, apirinu@unica.it*

<sup>2</sup> *University of Alicante, andresm.medina@gcloud.ua.es*

<sup>3</sup> *University of Cagliari, DICAAR, nicola.paba@gmail.com*

**Abstract** –The essay illustrates the choices aimed at building a digital database of military architectures made in Sardinia during the Second World War.

It is an historical cultural heritage characterized by an interesting landscape value, composed by more than 1.500 artifacts positioned along the coast of the island and designed to protect the urban centers and areas of strategic interest.

The small bunkers built adapting the models designed by the Italian and German Military Genius gave rise to an interesting repertoire.

The need for mimesis of these 'sentries' has in fact required an adaptation to the places of the typological solutions indicated in the archive documents.

A possible recovery and enhancement of this heritage necessarily passes through an activity of knowledge and cataloging entrusted to integrated digital survey methods.

## I. TOWARDS A DIGITAL DATABASE OF II WW SARDINIAN MILITARY ARCHITECTURES

The Sardinian coastal landscape is characterized by the presence of towers, built between the sixteenth and eighteenth centuries by the Spanish and Piedmontese Kingdom, in activity until the first half of the nineteenth century.

Designed to control the coasts, these architectures 'mark' the rhythm of a landscape shaped by high cliffs, coves, lagoon and sandy coasts. During the Second World War the same positions will be re-occupied by small reinforced concrete bunkers built in a very short time by the Italian and German Military Engineers to thwart an announced allied landing on the island.

This heritage, composed of "industrial pieces", today is mostly abandoned and lack of specific a protection and safeguard rules. In fact, no official cataloging activity [1] or specific regulation guarantees their protection or directs a possible reuse within historical and cultural itineraries. The only regulatory reference remains the PPR (Sardinian Landscape Plan) of Sardinia which identifies "refuges, bunkers and caves" [2] among the

'identity assets' subject to protection pursuant to art. 143 of Legislative Decree no. 42/2004.

However, the historical and cultural value of bunkers, representative architectures of a (recent) past not to be forgotten [3], is evident as well as the landscape value linked to their original position; in the past, sentries to control the sky, seas and cities and today, 'windows' to look and appreciate the landscape. Placed in different areas they make it difficult -but not impossible- to coordinate the intervention strategies. Abandoned along the sandy or rocky coasts, immersed in the rural or urban landscape of the major centers of the island, they coexist with the recent stratifications that have welcomed them.

The organization of a digital database projected to manage two-dimensional and three-dimensional models is the first step to reorganize the knowledge and plan a reuse of this built heritage.

To this aim digital survey methodologies support the recording of scientific data and information computer technologies allow the design of interoperable digital models.



Fig. 1. Tresnuraghes (OR), Natural Park "Molentargius-Saline" (Cagliari), Quartu Sant'Elena (CA), Santa Teresa Gallura (OT)

## II. BUILT A DIGITAL DATABASE OF II WW HERITAGE

The development of information technologies and tools for architectural and environmental survey and representation has facilitated the development of interesting initiatives aimed at cataloging the existing built heritage and at the creation of digital archives for their protection, recovery and enhancement.

Laser scanning technology and photogrammetric methods (and an increasingly use of drones, particularly useful in limited accessibility contexts) makes it possible to have a thorough knowledge of the architectural and material characteristics of historical centers, as well as monumental complexes, achieve three-dimensional representations of the landscape and create virtual tours and cultural heritage routes [4].

However, the bunkers of the Second World War only recently have been the subject of interest and studies aimed at an in-depth knowledge although a first cataloging (survey and classification) of the Atlantic Wall is dated 1985 and is due to the scholar Rolf Rudi [5].

A first investigation have highlighted an interesting affinity between the Spanish and Sardinian coasts, "Mediterranean" areas that share historical and architectural events since the Middle Ages and with particular intensity in the modern era. This research [6,7] has interested the design solutions adopted along the Spanish coast between Cadiz and Girona -specifically in the province of Alicante- and has defined a repertoire divided into categories (fig. 2).

The study was subsequently the subject of some insights, related to the disciplinary field of history of architecture and landscape representation [8], with particular attention to the relationship between the identified models and the watchtowers built from the second half of the sixteenth century along the coasts of Spain and Sardinia [9]. The design of a digital database of Sardinian architectures needs a geo-referenced cartographic base; for this purpose it is been identified the Regional Technical Map (C.T.R.) dated 1998 on a numerical scale of 1:10.000, modified to become GIS oriented, integrated by aerial surveys dated from 1954 to 2013 and by the maps prepared by the Italian Military Engineer on a numerical scale of 1:25.000 in the years 1941-42.

The compatibility between the selected documents allows an easy identification of the bunkers and the subsequent inspection aimed at verifying the site conditions and planning the survey operations.

The distribution of the architectures in different landscape contexts of the island requires a territorial planning of the surveys and a choice of some case studies on which to deepen the knowledge of the design characteristics and evaluate the landscape value.

To this end, field operations are conducted on different scales of investigation - architecture and landscape.

Through the use of integrated survey methodologies is possible to acquiring information on the architectural, geometric, material characteristics of single bunkers and landscape qualities of the contexts that host them; all of these data make up the scientific database (fig.3) and are aimed at cataloging and studying the military heritage.

Comparison with the archival models, examination of the state of degradation, analysis of the landscape value, also aimed at the construction of cultural itineraries, are just some of the possible uses of this catalog.

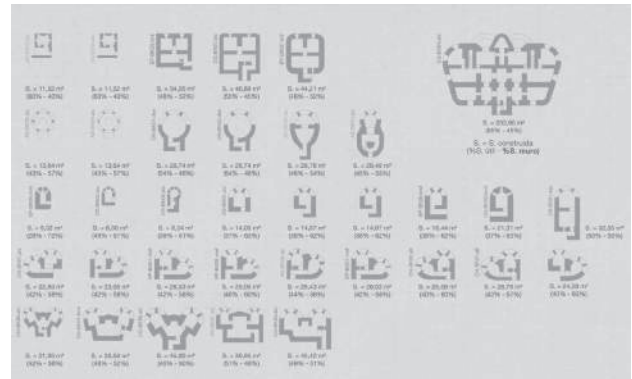


Fig. 2. Catalog of bunker built during the Spanish Civil War (1936-39) in the territory of Alicante (Martinez-Medina 2016)

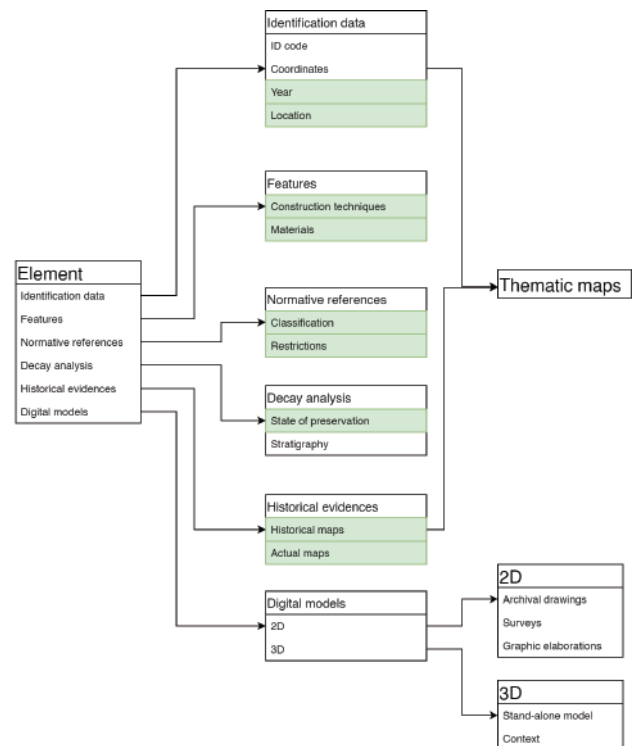


Fig. 3. Main structure of Sardinian IIW heritage database (design by A.Pirinu & R.Argiolas)



### III. SURVEY, REPRESENTATION AND CATALOGING IN THE “NATURAL PARK MOLENTARGIUS-SALINE” (CAGLIARI)

The interventions planned in Sardinia during the 1940s was carried out especially in the coastal area.

The projects are well described in the archival documentation kept in the Military Archive of Cagliari (*Archivio Documentale del XIV Reparto Infrastrutture Esercito*) and at the Historical Archive in Rome (*Archivio dell'Ufficio Storico Stato Maggiore Esercito*).

The bunkers location is identified on a IGM maps elaborated by the Military Engineers (fig. 4); it allows an easy recognition of works carried out.

Starting from an analysis of these documents a territorial survey has been realized; this first step as highlighted an interesting repertoire of design solutions that show the presence of models, that take up shapes (circle and square as in figg. 6-7-8) and dimensions indicated in the military catalog, sometime integrated with existing buildings (coastal towers, civil/industrial dwellings) in order to achieve a complete mimesis with the landscape.

One of the case studies investigated is the *Molentargius-Saline* compendium in Cagliari in which 11 bunkers are identified and cataloged; placed in 4 strategic points (sector 1,2,3,4) and visually connected to each other, they was built to control crossroads and canals. Some of them have been modified to disguise themselves by acquiring the shape of cisterns (figg. 9-10) or becoming part of some buildings built in the nineteenth century to support salt works activities (figg. 12-13).

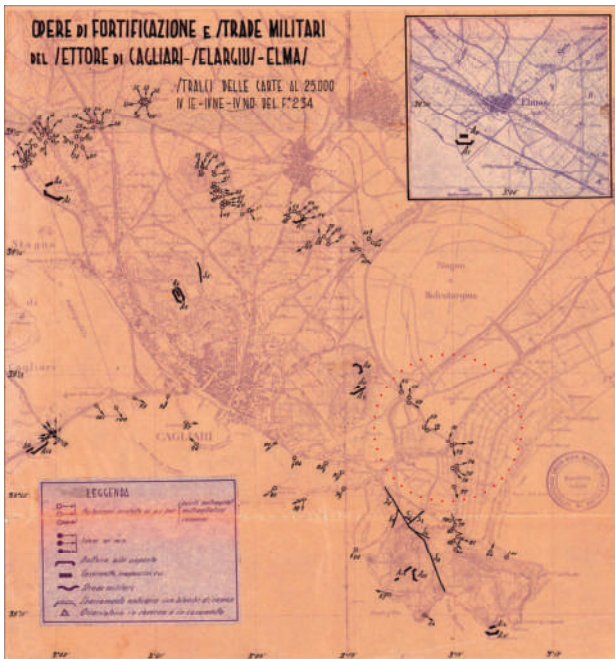


Fig. 4. Military works planned in the sector of Cagliari. The red dotted line identified the survey area

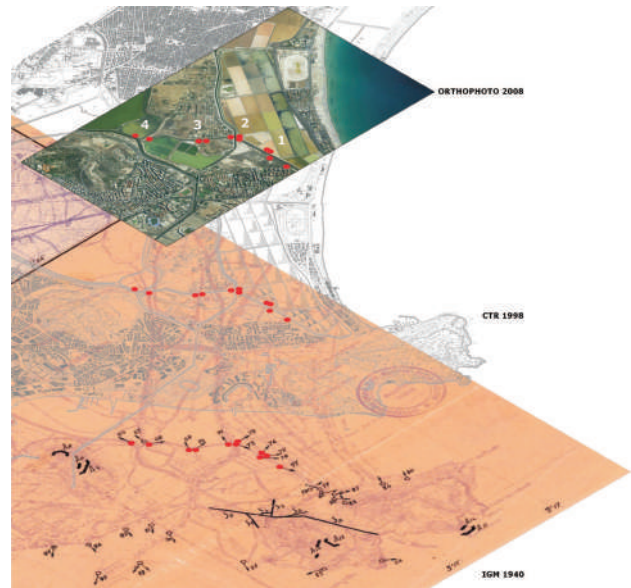


Fig. 5. Military works realized in the Natural Park of Molentargius-Saline (drawing and C.G.I. by A.Pirinu).



Fig. 6. Design model: circle + square in the sector 1



Fig. 7. Design model: circle + square - sector 2



*Fig. 8. Design model: circle + square - sector 3*



*Fig.11. Bunker positioned along the canal - sector 4*



*Fig.9. Bunker as a cylindrical water tank - sector 3*



*Fig.12. Bunker incorporated in a building - sector 1*



*Fig.10. Circle + rectangle (as a water tank) - sector 2*



*Fig.13. Bunker incorporated in a nineteenth century building to control waterways and road that connected in the 1940s Quartu Sant'Elena to Cagliari - sector 4*

In the area of the *Molentargius* (fig.14) the survey operations were entrusted to the photogrammetric method preceded and supported by a direct measurement of the internal and external dimension, useful to scale the model.

This procedure made it possible to record the architectural and dimensional characteristics of all the bunkers identified and to produce a digital representation, of which the sequence of images in figure 17 is an example.

Regarding the operational aspect, during the “design” of the survey, the use of drone was evaluated.

However, from an analysis of the ENAV (the company that manages civil air traffic in Italy) cartography, it is been verified that the airspace related to the site falls within the Natural Park *Molentargius-Saline* area, where flight is prohibited.

Consequently, it was not possible to make a wide view of the landscape context and survey operation were mainly conducted on the architectural scale.

The small size of the bunkers leads the choice for the use of an inexpensive Action Cam (20MegaPixel camera resolution) installed on a telescopic support (maximum capacity of 8 meters).

Despite the good technical characteristics, the files processed by the camera highlight a limit in terms of dynamic range and image sharpness; for this reason it was decided to make up for the poor quality of the image with a high number of shots.

This expedient has made it possible to achieve the intended purposes, that is the documentation of the bunkers (made with the use of simple construction models and regular surfaces in reinforced concrete of excellent quality) on the architectural scale.

The data processing was performed with Agisoft Metashape Professional v.1.5.3 in which the internal and external images were processed separately.

Once the point clouds were acquired, the "chunks" were joined with the "point based" method to obtain a complete and perfectly aligned "Dense Cloud".

Finally, the dense cloud was managed within the software Cloud Compare v.2.10.2 and used to process 2D and 3D digital representation.

All of this scientific information gives a further contribution to the construction of IIW Sardinian military architecture database and -together with the case studies already examined in the area of Bosa (OR) and Quartu Sant'Elena (CA) and to those still in progress in the north of the island in the territories of Santa Teresa Gallura (OT) and La Maddalena (OT)- to the recovery and enhancement of this important historical cultural heritage.



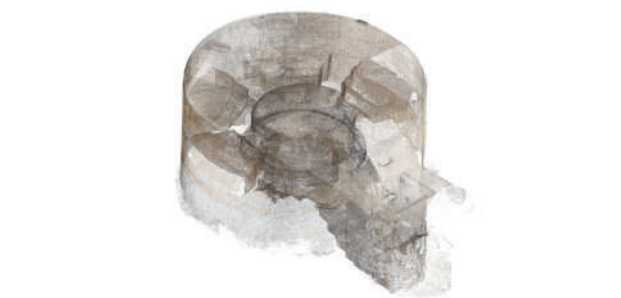
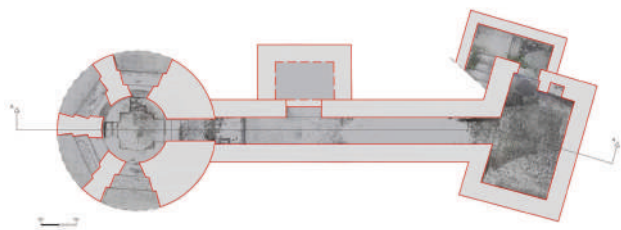
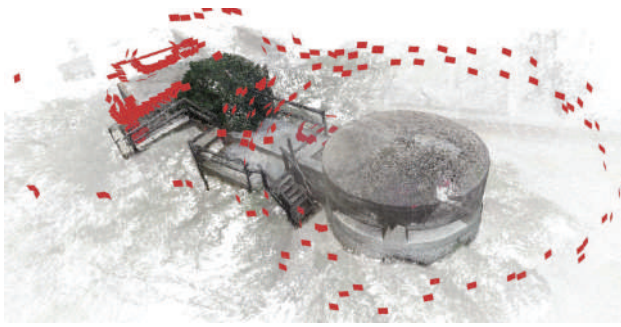
Fig. 14. Strategic points to control roads and waterways



Fig. 15. Bunker located in the sector 2



Fig. 16. Photographic survey– sector2



## References

- [1] A. Negri, “Catalogazione di beni culturali in Italia: metodi, strumenti e cooperazione tra sistemi informativi per la gestione della conoscenza”, *Rev. CPC*, Sao Paulo, n.21 especial, p.99-118, jan./jul. 2016.
- [2] M. Rassa, “Cantine, caverne, bunkers : la protezione antiaerea a Cagliari durante la Seconda Guerra mondiale”, 2013, A.R.S.O.M., Stampa ATENA. ET srl- Grisignano (VI).
- [3] A. Pirinu, “Conservare per ricordare. I fortini della seconda guerra mondiale – l’inutilità dell’inutile nel paesaggio costiero della Sardegna”, in *Agribusiness Paesaggio & Ambiente*, 2014, 1, pp.31-37.
- [4] S. Parrinello, F. Picchio, R. De Marco, and A. Dell’Amico, “Documenting the cultural heritage routes. The creation of informative models of historical Russian churches on upper Kama region”, (2019), *International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences*, XLII-2/W15, pp. 887–894.
- [5] R. Rudi, *Het Duitse fortificatie-ontwerp, 1935-1945*. Beetsterwaag: AMA editore, 1985.
- [6] A. Martínez-Medina, “Arquitecturas para la defensa de la costa Mediterránea (1936-1939)”, Universidad de Alicante, 2016; <http://hdl.handle.net/10045/81287> (last access 2 giugno 2020).
- [7] A. Martínez-Medina, A. Banyuls i Pérez, A. Pirinu, *El “Muro Mediterráneo” en el territorio de la Marina Alta: búnkeres y baterías de la Guerra de España (1936-1939)*, In *Defensive Architecture of the Mediterranean*, edited by Navarro Palazón, J. and Luis José García-Pulido Vol. XII, 1263-1270. Granada: Universidad de Granada, Universitat Politècnica de València, Patronato de la Alhambra y Generalife, 2020.
- [8] A. Pirinu, R. Argiolas, N. Paba, “UAVs and photogrammetry for landscape analysis of Sardinia’s modern wars architectures”, *Collana “Prospettive Multiple. Studi di Ingegneria, Architettura e Arte”*, Pavia University Press, 2020, a cura di S. Parrinello, S. Barba.
- [9] A. Martínez-Medina, A. Pirinu, “Entre la tierra y el cielo. Arquitecturas de la guerra en Cerdeña: un paisaje a conservar/Between earth and sky. War architecture’s in Sardinia: a landscape to preserve”, in *ArchHistoR*, 11/2019, Dipartimento PAU, Università Mediterranea di Reggio Calabria

*Fig.17. Digital models of surveyed bunker (drawing and C.G.I. by N.Paba, scientific coordinator A.Pirinu)*

## Index of Authors

- Adinolfi, Gloria, 512  
Adinolfi, Oreste, 144  
Agapiou, Athos, 174  
Alabiso, Annamaria, 590  
Albano, Michela, 461, 467, 481  
Albano, V., 316  
Alberti, Lucia, 9  
Aldrighettoni, Joel, 15  
Alessandri, Luca, 360  
Altadonna, Alessio, 287  
Andreoli, Martina, 548  
Andò, Sergio, 343  
Angelini, Emma, 96, 101, 517  
Antola, Michele, 38  
Antolini, Margherita, 617  
Antonelli, Fabrizio, 27, 404, 425, 472  
Apostolos, Sarris, 248  
Aquino, Andrea, 38, 44, 50, 179, 184, 196  
Aramaki, Mitsuko, 263  
Armetta, Francesco, 150  
Artioli, Gilberto, 348
- Baglini, Paolo, 50  
Baiocchi, Valerio, 360  
Balletti, Caterina, 304  
Barbara, Cafarelli, 248  
Barbino, Maurizio Paterniti, 453  
Barca, Donatella, 538  
Barone, Germana, 410, 501, 559  
Baumgartner, Marta, 360  
Beltrame, Carlo, 311  
Ben Chobba, Marwa, 527  
Bergerot, Laurent, 263  
Bernabei, Mauro, 579  
Bernardoni, Andrea, 517  
Bersani, Danilo, 501  
Bertelli, Marco, 328  
Bertino, Antonella, 559  
Bertola, Giulia, 66  
Betti, Michele, 453  
Bitelli, Gabriele, 366  
Blaise, Jean-Yves, 263  
Blanco, Diego, 360  
Boanini, Elisabetta, 328  
Boccia, M.P., 477  
Bolzacchini, Ezio, 651  
Bonelli, Donatella, 435  
Bonizzoni, Letizia, 251  
Bonomi, Roberto, 328  
Borghini, Silvia, 410  
Borla, Matilde, 623  
Bosco, Angela, 220  
Bosman, Alessandro, 360
- Branchini, Paolo, 496  
Brienza, Emanuele, 60  
Brini, A., 384  
Brogiolo, Gian Pietro, 522  
Brunetti, A., 399  
Buccolieri, Riccardo, 486  
Buffone, Luigi, 425  
Buono, Giulia, 554  
Buscaglia, Paola, 623
- Caggiani, Maria Cristina, 410  
Cagnini, A., 384  
Camin, Federica, 646  
Campobello, Giuseppe, 287  
Cancelliere, Stefano, 425  
Canevari, Claudio, 461  
Cantelli, Margherita, 585  
Cantini, Francesco, 384  
Cantini, Lorenzo, 293  
Canu, A., 399  
Capozzoli, Luigi, 238, 257, 457, 477  
Cappelletti, Giuseppe, 629  
Capuani, Silvia, 570  
Carcangiu, Gianfranco, 189  
Cardell, Carolina, 641  
Cardone, Luigi, 360  
Carmagnola, Rodolfo, 512  
Carni, Domenico Luca, 106, 112, 298  
Carpentiero, Laura, 220  
Castellano, Anna, 117, 123  
Castelli, Lisa, 507  
Cataldo, Matteo, 399  
Causarano, Marie Ange, 522  
Cavaleri, Tiziana, 623  
Cavaliere, Francesco, 372  
Cavallaro, Antonio, 242  
Cavalli, Fabio, 600  
Cazzaniga, Carlo, 389  
Cecchi, Vanni Moggi, 184  
Cesareo, Roberto, 496  
Chavarría, Alejandra, 522  
Cheney, Sylvie, 491  
Chiantore, Oscar, 343  
Ciaramitaro, Veronica, 150  
Clemenza, Massimiliano, 389  
Coccatto, Alessia, 410  
Colella, Mario, 467  
Colica, Emanuele, 453, 532  
Colosi, Francesca, 9  
Colucci, Alessandro, 281  
Columbu, Stefano, 184, 189, 196  
Comelli, Daniela, 461  
Comisi, Filippo, 1

Comite, Valeria, 328, 333, 435, 467, 548, 629, 641  
Conry, Patrick, 486  
Costa, Elisa, 311  
Cozzella, Lorenzo, 420  
Crescenza, Calculli, 248  
Crocco, Maria Caterina, 112  
Crupi, Vincenza, 532  
Cucciniello, Raffaele, 635, 651  
Cunha, Eugénia, 600  
Czelusniak, Caroline, 507

D'Andrea, Andrea, 220  
D'Urso, Maria Grazia, 372  
Dabrowski, Marcin, 304  
Daffara, Claudia, 611  
Danese, Maria, 160  
Davit, Patrizia, 415  
de Buergo, Monica Alvarez, 431  
De Giorgi, Lara, 1, 129, 133, 136, 140, 440, 444  
De Marco, Raffaella, 226  
De Martino, Gregori, 477  
De Martino, Gregory, 457  
De Pascalis, Giancarlo, 136  
Degano, Iliaria, 343  
Del Vesco, Paolo, 623  
Della Torre, Stefano, 293  
Delli Santi, Maurizio, 448  
Demarco, Lorenzo, 298  
Depalmas, A., 399  
Di Angelo, Luca, 168  
Di Gangi, Giorgio, 491  
Di Martino, Daniela, 389  
Di Nicola, Francesca, 486  
Di Petta, Claudio, 44  
Di Sabatino, Silvana, 486  
Di Stefano, Paolo, 168  
Diceglie, Angela, 275  
Ding, Yufan, 101  
Donato, Nicola, 287  
Dondi, Piercarlo, 461  
Doria, Elisabetta, 269  
Dudek, Iwona, 263  
D'Amico, Sebastiano, 453, 532

Ema, Natalia Perez, 431  
Enzo, Stefano, 600  
Eric, Miran, 378  
Es Sebar, Leila, 517

Fabbrocino, Giovanni, 214  
Facchi, Alberta, 585  
Fancello, Dario, 189  
Fargeot, Simon, 263  
Farina, Hermes, 629  
Fedrigo, A., 399  
Fermo, Paola, 328, 333, 435, 467, 548, 629, 641  
Fernando, H. J. S., 486  
Ferrari, Ivan, 136

Ferrero, Luca, 651  
Festa, Giulia, 150  
Filardi, Rita, 517  
Fiocco, Giacomo, 461, 467, 481  
Fiorentino, Antonino, 635  
Fiorenza, Elia, 538  
Fiorillo, Rosa, 646  
Fioriti, Vincenzo, 281  
Forliti, Sara, 281  
Fornaciari, Lorenzo, 60  
Fort, Rafael, 431  
Foti, Salvatore, 453  
Fraddosio, Aguinardo, 117, 123  
Fragalá, Giovanni, 444  
Fugazzotto, Maura, 559

Gabellone, Francesco, 5, 90, 232  
Galasso, Francesca, 269  
Galeotti, M., 384  
Galone, Luciano, 453, 532  
Garcia, Sayri, 238, 257  
Gargano, Marco, 251  
Gattuso, Caterina, 202  
Gebreyesus, Yohannes, 415  
Genga, Alessandra, 486  
Gerbino, Salvatore, 214  
Germanò, Germano, 605  
Gheboianu, Anca Irina, 564  
Gialanella, Stefano, 594  
Giamello, Marco, 196  
Gigante, Giovanni Ettore, 496  
Gigli, Stefania Quilici, 164  
Giotta, Livia, 486  
Girelli, Valentina Alena, 366  
Giuffrida, Dario, 144  
Giuntini, Lorenzo, 507  
Giuri, Francesco, 136  
Giustetto, Roberto, 415  
Gizzi, Fabrizio Terenzio, 5, 477  
Gonçalves, David, 600  
Gori, Andrea, 96  
Grassini, Sabrina, 517, 623  
Grazzi, F., 384, 399  
Grifoni, Emanuela, 251  
Grillanda, Nicola, 293  
Grimaldi, Stefano, 594  
Guaglianone, Andrea, 360  
Guardiani, E., 168  
Guerra, Francesco, 304  
Guglielmi, Vittoria, 548  
Guido, Sante, 532  
Guidorzi, Laura, 507  
Gulmini, Monica, 415

Hadjimitsis, Diofantos, 174

Iannucci, Leonardo, 517  
Ielpo, Pierina, 486

Innocenti, Dario, 600  
Ion, Rodica-Mariana, 564  
Izzo, Francesca C., 585

Jaklic, Ales, 378

Korat, Lidija, 378  
Kronland-Martinet, Richard, 263

La Russa, Mauro Francesco, 333, 431, 472, 543  
Lamonaca, Francesco, 106, 112, 298  
Lapenna, Vincenzo, 457  
Lasaponara, Rosa, 160, 238, 257  
Laureti, Stefano, 543  
Lazzari, Mario A., 481  
Lazzari, Maurizio, 129  
Lazzarini, Lorenzo, 425  
Lebole, Chiara Maria, 491  
Leccese, Fabio, 420  
Legnaioli, S., 512  
Leucci, Giovanni, 1, 5, 129, 133, 136, 140, 440, 444  
Lezzerini, Marco, 38, 44, 50, 55, 179, 184, 196, 554  
Licchelli, Maurizio, 461, 527  
Limongiello, Marco, 316  
Lins, Sergio Augusto Barcellos, 496  
Lo Giudice, Alessandro, 415, 507, 623  
Longo, Sveva, 570  
Lucchini, Alice, 579  
Ludwig, Nicola, 251  
Lupano, Greta, 491  
Lysandrou, Vasiliki, 174

Majolino, Domenico, 532  
Malagodi, Marco, 461, 467, 481  
Malfitana, Daniele, 444  
Mandanici, Emanuele, 366  
Mandelli, Chiara, 415  
Manso, Marta, 496  
Mantella, Giuseppe, 532  
Manzari, Valerio, 372  
Marana, Barbara, 372  
Marchioro, Giacomo, 611  
Marchioron, Silvia, 467  
Marcucci, Giulia, 389  
Mariangela, Noviello, 248  
Maritan, Lara, 415, 522  
Marmo, Francesco, 372  
Marra, Adriana, 214  
Marras, Luciano, 512  
Marrocchino, Elena, 32, 354  
Martinelli, Nicoletta, 575  
Martínez-Medina, Andrés, 208  
Marzaioli, Fabio, 348  
Masini, Nicola, 5, 160, 238, 257, 477  
Massa, Serena, 415  
Massi, Mirko, 507  
Mastelloni, Maria Amalia, 144  
Mazhen, Saltanat T., 394

Mazzaglia, Antonino, 444  
Mazzinghi, Anna, 507  
Mazzocato, Sara, 611  
Mazzoleni, Paolo, 410, 501, 559  
Melada, Jacopo, 251  
Meloni, Paola, 189  
Menegazzi, Alessandra, 611  
Merlo, Curzio, 481  
Merola, Pasquale, 9  
Miceli, Alessia, 226  
Migliore, Luciana, 590  
Mignani, Ilaria, 251  
Milani, Gabriele, 117, 123, 293  
Mimokhod, Roman A., 394  
Minucci, Eleonora, 220  
Mirão, José, 101  
Modugno, Francesca, 343  
Monfasani, Elisa, 328  
Monserrat, Elena Pérez, 522  
Morabito, Anna Eva, 168  
Morandini, F., 384  
Morandotti, Marco, 269  
Morelli, Gianfranco, 155  
Motta, Oriana, 635, 646, 651  
Muto, Silvia, 472

Nardo, Viviana Mollica, 144, 150  
Natalia, Rovella, 338  
Natta, Fabrizio, 72  
Nervo, Marco, 507, 623  
Neuwahl, Alexander, 517  
Novara, Paola, 32

Olivito, Renato S., 106, 298  
Olivito, Renato Sante, 112  
Onori, Matteo, 360  
Orlandi, Marco, 343  
Ortenzi, Marco Aldo, 629

Paba, Nicola, 208  
Pacchini, Alessio, 38  
Pagnotta, Stefano, 38, 44, 50, 55, 179, 184, 196, 554  
Paladini, Giuseppe, 532  
Palleschi, V., 512  
Pamart, Anthony, 263  
Paola, Mairota, 248  
Papale, Enrico, 164  
Pargoletti, Eleonora, 629  
Parrinello, Sandro, 226  
Parvis, Marco, 517  
Passariello, Isabella, 348  
Patera, A., 384  
Pavan, Alexia, 554  
Pecchioni, Elena, 184  
Perciante, Felice, 457  
Perez, Andrea, 594  
Perini, Nicoletta, 590  
Persico, Raffaele, 129, 155, 453

Piccioni, Mario Daniele, 117, 123  
Piga, Giampaolo, 600  
Pigozzi, Marinella, 366  
Piovesan, Rebecca, 27  
Pirinu, Andrea, 208  
Piro, Salvatore, 164  
Pironti, Concetta, 635, 646, 651  
Ponterio, Rosina Celeste, 144, 150  
Porcinai, S., 384  
Porzio, Saverio, 298  
Pozo-Antonio, José Santiago, 641  
Proto, Antonio, 635, 646, 651  
Puhar, Enej Gucek, 378

Quendolo, Alessandra, 15

Rabbia, Anna, 322  
Randazzo, Luciana, 472  
Raneri, Simona, 501, 512  
Re, Alessandro, 415, 507, 623  
Redol, Pedro, 101  
Ricca, Michela, 543  
Ricci, Giulia, 348  
Ricci, Marco, 543  
Ricciardi, Maria, 635, 646, 651  
Ricetti, Valentina, 461  
Ridolfi, Stefano, 496  
Riedo, Chiara, 343  
Rizzo, Carlotta, 554  
Rizzo, Enzo, 457  
Rizzo, Maria Luigia, 457  
Rodriguez, Manuel Garcia, 431  
Ronchi, Diego, 316  
Ronco, Francesca, 78  
Roselli, Ivan, 281  
Rostagno, Chiara, 651  
Roubis, Dimitris, 140  
Rovella, Natalia, 472, 538  
Rovetta, Tommaso, 481  
Ruberto, Chiara, 507  
Russo, Alfonsina, 410, 559

Sabatini, Valentina, 629  
Saladino, Maria Luisa, 150  
Saliu, Francesco, 343  
Sammartano, Giulia, 322  
Santaniello, Fabio, 594  
Saprykina, Irina A., 394  
Savini, Francesca, 84  
Scacco, Jacopo, 117, 123  
Scafuro, Michele, 457  
Scalarone, Dominique, 343  
Scatigno, Claudia, 150  
Scherrillo, Antonella, 384, 389, 399  
Schiavon, Nicola, 101  
Scuro, Carmelo, 106, 112, 298  
Secco, Michele, 348  
Sedyshev, Pavel V., 394

Serritella, Antonia, 457  
Setnescu, Radu, 564  
Setnescu, Tanta, 564  
Sileo, Maria, 238, 257, 477  
Simbirtseva, Nina V., 394  
Solina, Franc, 378  
Sottili, Leandro, 507  
Spagnolo, Giuseppe Schirripa, 420  
Spampinato, Marcello, 179  
Spanò, Antonia, 322  
Stagno, Valeria, 570  
Stroscio, Antonio, 559

Taccetti, Francesco, 507  
Taelman, Devi, 404  
Tamponi, Marco, 44, 50  
Tasso, Francesca, 461  
Tatì, Angelo, 281  
Telloli, Chiara, 32, 354  
Tenorio, Anna Lluveras, 55  
Terrasi, Filippo, 348  
Tesser, Elena, 27, 472  
Tincu, Sorin, 564  
Tinè, Maria Rosaria, 55  
Todesco, Fabio, 287  
Tortora, Luca, 496  
Tredici, Ilenia, 527  
Triolo, Paolo, 512  
Trizio, Ilaria, 84

Vaccaro, Carmela, 32, 354  
Valentini, Rosario, 220  
Valli, Ludovico, 486  
Valluzzi, Maria Rosa, 348  
Van Limbergen, Dimitri, 404  
Vannucci, Giulia, 366  
Varas, María J., 431  
Vasilievici, Gabriel, 564  
Vatore, Felicia, 360  
Venuti, Valentina, 532  
Vera, David, 238, 257  
Vernier, Paolo, 304  
Vidal, Adrien, 263  
Vigorelli, Luisa, 623  
Vincenti, Maria Lisa, 486  
Violante, Crescenzo, 21  
Voza, Ottavia, 457

Weththimuni, Maduka L., 527

Yergashov, Almat M., 394  
Ystad, Solvi, 263

Zaccariello, Gloria, 27  
Zamuner, Daniela, 164  
Zarella, Matilde, 106  
Zendri, Elisabetta, 585  
Zerai, Abraham, 415