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INTRODUCING "ADVANCES AND APPLICATIONS IN GEOFORENSICS: UNRAVELING CRIMES WITH GEOLOGY"

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ABSTRACT. Preface to the AAPP special issue gathering the proceedings of the International Workshop on "Advances and Applications in Geoforensics: Unraveling Crimes with Geology" (26th September 2022, Messina, Italy).

1. The workshop

The International Workshop on "Advances and Applications in Geoforensics: Unraveling Crimes with Geology" (26th September 2022, University of Messina, Italy) was a scientific hybrid event devoted to sharing original research results and innovative applications in the discipline of Geoforensics. The workshop emphasized the importance of multi-, inter-, and trans-disciplinary scientific approaches, promoting scientific dissemination and dialogue among experts in the different disciplines involved in Geoforensics. Through on-site and online selected keynotes, invited lectures, and poster presentations (Figures 1-3), the meeting offered to the attendees a privileged occasion for facilitating cultural and scientific exchanges, giving a beneficial opportunity to increase international scientific collaborations. The most relevant communications were selected and collected in this special issue entitled "Advances and Applications in Geoforensics: Unraveling Crimes with Geology". This special issue was aimed to evidence the key role played by Geoforensics in the field of Forensic Sciences. On that score, the issue examined methodological topics and case studies concerning research in Earth, Natural, Environmental, and Life Sciences.

FIGURE 1. The prestigious hall of the Accademia Peloritana dei Pericolanti.

FIGURE 2. Group photography with some of the workshop participants (Profs. Alessio Altadonna, Filippo Cucinotta, Antonella Cinzia Marra, Marina Morabito, Anselme Muzirafuti, Luigia Puccio, Daniela Sapienza, Roberta Somma. Forensic Science Police Drs. Maria Teresa Allia, Giuseppe Cardia, Francesco Sudoso. Drs. Ahmed Alì Mohamed, Najmeh Ayoqi, Emanuele Barberi, Serena Barone, Matteo Bolignani, Giorgia Burrascano, Elena Maria Donata Forzese, Dominic Antonio Iannello, Adam Malik, Thomas Mancuso, Fabio Mondello, Giuseppe Paladini, Claudia Pitrone, Fabio Salmeri, Sebastiano Ettore Spoto, Giulia Tagliabue. Ing. Armando Mellini, Geom. Letterio Rodilosso. Location: Hall Gustavo Ricevuto of the University of Messina).

FIGURE 3. Some moments of the hybrid workshop in the hall Gustavo Ricevuto of the University of Messina.

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2. The Special Issue

The present special issue is devoted to Geoforensics, also known as Forensic Geology or Geosciences. It is a criminalistic discipline among many others, such as legal medicine, entomology, botanics, genetics, fingerprinting, and ballistic. Geoforensics is used by police and forensic experts in Forensic Geology and Soil Science to help the judicial system in solving crimes such as homicides, corpse concealments, hit and run incidents, kidnappings, sexual assaults, animal maltreating and wildlife crimes, fraud crimes (fake fossils, gemstones frauds), financial crimes, robberies, and environmental damages. In most crime scenes in open space, the possibility that geological (and botanical) evidence transfers from the scene to the victim or the suspect is high. The probatory weight assumed by the geological and botanical materials collected from the crime and *alibi* scenes and questioned items may be crucial in such circumstances: analyzing geological and botanical evidence proved successful in several cases. Moreover, the 3D reconstruction of items of investigative interest and the reconstruction of the geographical, geological, topographical, geomorphological, and botanical features of the sites linked to crimes may provide significant info-investigative contributions and may be incriminating when analyzed by multidisciplinary teams of forensic experts, such as geologists, naturalists, botanists, entomologists, engineers, chemists, and physicians, to support legal medicine investigation. An emerging field of investigation is related to palaeontological and gemmological studies to ascertain possible frauds related fakes or false provenances. Another critical aspect that may be linked and overlapped with Earth Sciences investigations is the contribution of the experts in Geographical Offender Profiling (geographers and investigative psychologists). They individuate and analyze the geographical and psychological characteristics of the sites influencing the criminal behaviour of perpetrators, mainly responsible for serial crimes.
With this in mind, the special issue wants to stress the importance of the multi-, inter-, and trans-disciplinary scientific approaches in Forensic Sciences.
The volume is subdivided in nineteen chapters of which the first 17 are related to criminalistic disciplines, whereas the last 2 cover both criminalistic and criminological issues. Most of the chapters describes methods and their applications, providing useful examples related to case works.
The first two chapters are introductory and centred in a general overview of Geoforensics.

Chapter 1 is devoted to briefly introduce the role of different Earth Science disciplines, such as geochemistry, geophysics, sedimentology, remote sensing, and mineralogy, in the applications to forensic issues (Spoto, Barone, and Somma 2023).

Chapter 2 is aimed to depict general overview of the main activities carried out by forensic geologists in criminal cases involving comparative analyses and provenance studies of geological evidence, search for clandestine graves, and environmental damages (Somma 2023c).

Chapter 3 introduces one aspect of the issue related to gemstones discussing the illicit trafficking of some geological evidence such as diamonds. The role of the Kimberley process in the management of "conflict diamonds" is depicted (Spoto 2023).

Chapter 4 illustrates the main activities accomplished by palaeontologists in criminal investigations, such as the classification of microfossils for comparative analyses, the characterization of illegal fossils suspected to be object of illegal activities, or the taphonomical

approach in the study of clandestine burials. The research is accompanied by the description of several case studies (Marra, Di Silvestro, and Somma 2023).
Chapters from 5 to 8 are devoted to gravesites.

Chapter 5 deals with the appearance of clandestine gravesites, the factors influencing the concealers in the choice of the site, the approaches used for ground search, included the Red-Amber-Green search prioritization system (Somma, Sutton, and Byrd 2023).

Chapter 6 focuses on the taphonomical approach used in searching activities for clandestine graves (Marra 2023).

Chapter 7 describes the activities carried out by forensic entomologists for the identification, documentation, collection, and analyses of insect evidence in cases of medicolegal death investigation related to corpse concealments (Byrd and Sutton 2023).

Chapter 8 shows the main results of the biogeochemical analyses of an anthrosol hosting skeletal remains found in the *Sepolcreto* of the *Chapter Ca' Granda* crypt (Milan, Italy) (Tagliabue *et al.* 2023).
Chapters from 9 to 13 concern different forensic case works occurred outdoor in the countryside, where geological and botanical evidence were analysed with comparative and provenance purposes.

Chapter 9 focuses on the results of geological and micropalaeontological comparative analyses on forensic samples related to a murder case. A discussion on the provenance of the geological material was reported (Somma and Maniscalco 2023).

Chapter 10 reports the results of geological and botanical comparative analyses on forensic specimens regarding a forensic case work of presumed kidnapping. The obtained data allowed to trace the path followed by the victims in the crime scene (Somma *et al.* 2023c).

Chapter 11 illustrates the results of botanical and geological comparative analyses on forensic samples regarding a forensic case work of missing people. The association of soil and freshwater algae allowed to geolocalize one victim in a specific site of the crime scene (Morabito and Somma 2023).

Chapter 12 shows the results of the application of the Computed Axial Tomography technology on a pair of sandals belonging to the victim of a presumed kidnapping. This technology permitted to characterize the occurrence of extraneous material of investigative interest (thorns), fixed in the soles (Somma 2023a).

Chapter 13 deals with an investigation regarding a forensic case work of missing people. The victims' path, based on the punctual distribution of plants (thorns, leaves, seeds) and soils permitted to trace the passage of the victims in specific sites of the studied territory (Morabito, Mondello, and Somma 2023).

Chapter 14 reports the results of comparative analyses, carried out in a simulated case study, on soils. Analyses, based on color examination, showed as digital devises, such as low-cost flatbed scanners, if calibrated, may provide useful data on colors (Somma *et al.* 2023d).
Chapters from 15 to 18 are devoted to the application of 3D technologies in crime scene investigation and education.

Chapter 15 reports the results of several case studies involving the application of 3D laser scanning and structured blue light scanning used for reconstructing 3D virtual models of large-, medium-, and small-scale forensic scenarios (Somma *et al.* 2023a).

Chapter 16 shows education and training activities, based on the application of laser scanner technology, carried out in forensic and biomedical sciences (Somma *et al.* 2023b).

Chapter 17 describes the application of 3D laser scanners for the crystallization of indoor and outdoor crime scenes, included the ground above a clandestine grave (Baldino *et al.* 2023).

Chapters 18 and 19 are devoted to research linking criminalistic and criminological topics related to the space and time behaviour of serial killers.

Chapter 18 reports results of the application of GIS (Geographical Information System)-based RAG (Red-Amber-Green) color-coded search priority maps to the case of the monster of Florence (northern Italy). The method was aimed for predictive purposes to prevent future serial homicides in the hypothesis the killer was still alive (Somma and Costa 2023).

Chapter 19 reports the final research at conclusion of the special issue. The chapter is devoted to highlight as the geographical and territorial features of the sites chosen by serial killers may be factors influencing their specific criminal behaviour in space and time (Somma 2023b).

Acknowledgments

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A special thank is also due to all the speakers and participants whose active presence was the real success of the workshop.

We are grateful to Prof. Paolo V. Giaquinta, director of the Science Division of the Accademia Peloritana dei Pericolanti and editor of the Atti dell'Accademia Peloritana dei Pericolanti (AAPP), for having suggested and invited us to publish this supplementary number.

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Last but not least, we strongly appreciated the foreword to this supplementary number, written by Alison Galloway (Galloway 2023). Alison Galloway is one of the most skilled forensic experts in USA. Professor *Emerita* of Anthropology, she worked at the University of Tennessee and at the University of California. She earned several awards and contributed significantly to academic literature in Anthropology during her academic career. She is called upon by the authorities to provide her expertise as forensic expert in Anthropology.

We wish to dedicate this volume to the memory of Dr. Tiziano Granata, PhD, dear friend, chemist degreed at the Messina University, and policeman who dedicated his life to fight illegal activities in the field of environmental damages and animal maltreatments.

References

Baldino, G., Ventura Spagnolo, E., Fodale, V., Pennisi, C., Mondello, C., Altadonna, A., Raffaele, M., Salmeri, F., Somma, R., Asmundo, A., and Sapienza, D. (2023). "The application of 3D virtual models in the judicial inspection of indoor and outdoor crime scenes". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A17. DOI: 10.1478/AAPP.101S1A17.

Byrd, J. H. and Sutton, L. (2023). "The Use of Forensic Entomology within Clandestine Gravesite Investigations". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A7. DOI: 10.1478/AAPP.101S1A7.

Galloway, A. (2023). "Foreword". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), E1. DOI: 10.1478/AAPP.101S1E1.

Marra, A. C. (2023). "Taphonomical investigation applied to clandestine graves". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A6. DOI: 10.1478/AAPP.101S1A6.

Marra, A. C., Di Silvestro, G., and Somma, R. (2023). "Palaeontology applied to criminal investigation". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A4. DOI: 10.1478/AAPP.101S1A4.

Morabito, M., Mondello, F., and Somma, R. (2023). "Macrobotanic data implementing Forensic Geology investigations". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A13. DOI: 10.1478/AAPP.101S1A13.

Morabito, M. and Somma, R. (2023). "The crucial role of Forensic Botany in the solution of judicial cases". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A11. DOI: 10.1478/AAPP.101S1A11.

Somma, R. (2023a). "A multidisciplinary approach based on the cooperation of forensic geologists, botanists, and engineers: Computed Axial Tomography applied to a case work". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A12. DOI: 10.1478/AAPP.101S1A12.

Somma, R. (2023b). "The space and time dimensions in the criminal behaviour of lust murderers". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A19. DOI: 10.1478/AAPP.101S1A19.

Somma, R. (2023c). "Unraveling crimes with geosciences". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A2. DOI: 10.1478/AAPP.101S1A2.

Somma, R., Altadonna, A., Cucinotta, F., Raffaele, M., Salmeri, F., Baldino, G., Ventura Spagnolo, E., and Sapienza, D. (2023a). "The technologies of Laser Scanning and Structured Blue Light Scanning applied to criminal investigation: case studies". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A15. DOI: 10.1478/AAPP.101S1A15.

Somma, R., Baldino, G., Altadonna, A., Asmundo, A., Fodale, V., Gualniera P. abd Mondello, C., Pennisi, C., Raffaele, M., Salmeri, F., Ventura Spagnolo, E., and Sapienza, D. (2023b). "Education and training activities in forensic and biomedical sciences: The Laser scanner technology". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A16. DOI: 10.1478/AAPP.101S1A16.

Somma, R., Cascio, M., Cucinotta, F., Mondello, F., and Morabito, M. (2023c). "Recent advances in forensic geology and botany for the reconstruction of event dynamics in outdoor crime scenes: a case study". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A10. DOI: 10.1478/AAPP.101S1A10.

Somma, R. and Costa, N. (2023). "GIS-based RAG-coded search priority scenarios for predictive maps to prevent future serial serious crimes: the case study of the Florence Monster". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A18. DOI: 10.1478/AAPP.101S1A18.

Somma, R. and Maniscalco, R. (2023). "Forensic geology applied to criminal investigation: a case report". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A9. DOI: 10.1478/AAPP.101S1A9.

Somma, R., Spoto, S. E., Raffaele, M., and Salmeri, F. (2023d). "Measuring color techniques for forensic comparative analyses of geological evidence". *Atti della Accademia Peloritana dei*

Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali **101**(S1), A14. DOI: 10.1478/AAPP.101S1A14.

Somma, R., Sutton, L., and Byrd, J. H. (2023). "Forensic geology applied to the search for homicide graves". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A5. DOI: 10.1478/AAPP.101S1A5.

Spoto, S. E. (2023). "Illicit trafficking of diamonds: new frontiers". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A3. DOI: 10.1478/AAPP.101S1A3.

Spoto, S. E., Barone, S., and Somma, R. (2023). "An introduction to forensic geosciences". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A1. DOI: 10.1478/AAPP.101S1A1.

Tagliabue, G., Masseroli, A., Mattia, M., Sala, C., Belgiovine, E., Capuzzo, D., Galimberti, P., Slavazzi, F., Cattaneo, C., and Trombino, L. (2023). "Thanatogenic Anthrosols: a geoforensic approach to the exploration of the Sepolcreto of the Ca' Granda (Milan)". *Atti della Accademia Peloritana dei Pericolanti. Classe di Scienze Fisiche, Matematiche e Naturali* **101**(S1), A8. DOI: 10.1478/AAPP.101S1A8.

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