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Tracking the Route Walked by Missing Persons and Fugitives: A Geoforensics Casework (Italy)

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Abstract: Criminal investigations aiming to track the route walked by missing persons and fugitives (MPFs) usually involve intelligence analysts, military planners, experts in mobile forensics, traditional investigative methods, and sniffer dog handlers. Nonetheless, when MPFs are devoid of any technological device and move in uninhabited rural areas devoid of tele cameras and densely covered by vegetation, tracking the route walked by MPFs may be a much more arduous task. In the XVIII century, the expert Georg Popp was able to link a homicide suspect to a sequence of different sites of criminal interest, located in the countryside, by studying the stains of soils found on the footwear and trousers of the suspect. In such complex cases, a very efficient approach for tracking the route walked by MPFs may consist of comparing the geological traces found on the MPFs and their belongings with soils exposed in the event scenes. In particular, the search for peculiar or rare particles and aggregates may strengthen the weight of the geological forensic evidence comparisons. A match of mineralogical, textural, and organic matter data may demonstrate the provenance of the traces from the soil of a specific site, thereby linking the MPFs to the scene of events. Based on the above, the present paper reports geological determinations accomplished for a "mediatic" casework. The results allowed a general high degree of compatibility among traces collected on the MPFs and on the soil from the scene of events to be ascertained. The most significant positive matches, based on the finding of ten peculiar and rare particles and assemblages, allowed the reconstruction of a route about 1.1 km long, as the crow flies, on the event site. Although this procedure was extremely time consuming and available only in a backwards reconstruction linked to the MPFs' findings, it was of uttermost importance in strengthening the inferences proposed, and for which other methods could not provide any information.

Keywords: geoforensics (forensic geology); sedimentology; provenance; comparative analyses; missing persons and fugitives

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1. Introduction

Since the 11 September 2001 attacks and the Global War on Terror, the organizational structures and procedures devoted to the search for persons of national and international interest assumed an important role in global counterterrorism strategies [1,2]. In particular, criminal investigations aiming to track routes walked by missing persons and fugitives (MPFs) in urban and rural territory usually involve intelligence analysts (IMINT—Imagery Intelligence, OSINT—Open Source Intelligence, etc.), military planners, experts in mobile forensics sniffer, dog handlers, and traditional investigative methods [1,3]. Nonetheless, to track the route traversed by the MPFs may be a very arduous task when the MPFs do not carry mobiles, GPS, or any other technological devices, and they move in uninhabited rural areas of the countryside devoid of security or private tele cameras and covered by dense vegetation. In such peculiar circumstances, as demonstrated since the end of the XVIII and beginning of the XIX centuries [4–6], the mapping of the paths walked by the actors of crimes can be realized thanks to comparative analyses based on geological and soil forensic evidence collected on the crime actors and the scenes of the events, respectively. In

Germany, an expert, Georg Popp, solved different homicide cases using micro-stratigraphy. Procedures of micro-stratigraphic sampling and analyses of the footwear of a homicide suspect may provide a small vertical-scale record testifying the lateral movement of the suspect on different sites of the crime scene, due to the contact of the footwear on the topsoil and the related soil/sediment transfer to the suspect [4].

Nowadays, once the MPFs are found, dead or alive, a very efficient backwards criminalistic approach may consist of comparing both the geological traces and micro-traces found on the MPFs' belongings (unknown samples, i.e., of unknown provenance) with soils/sediments and plants exposed in the sites of finding, last sighting, alibi, and investigative interest (known samples, i.e., field samples of known provenance). A match of the comparative analysis data may demonstrate the provenance of the unknown traces from a site showing analogous microenvironmental characteristics [7].

Despite the positive results and practical aspects of such investigations, in Italy, forensic geology currently still represents a minor discipline of the forensic sciences panorama. For this reason, this paper is addressed especially to prosecutors, police forces, and politicians in order to demonstrate that this criminalistic discipline should be developed in the future.

With this in mind, the present research reports the scientific method and main results of geological comparative analyses requested by the judicial authority to solve a "mediatic" forensic casework that occurred in the Italian countryside a few years ago. Geological data allowed the tracking of the route walked by the two MPFs, revealing very useful information for the consequent criminological and criminalistic implications.

2. Geoforensics

Forensic sciences, based on a holistic approach, uses different multi-disciplinary and transdisciplinary disciplines, such as criminology and criminalistics (forensic medicine, forensic pathology, dentistry, toxicology, serology, anthropology, archaeology, entomology, physics, biology, chemistry, computer science, geology, and botany, among many others) [8,9]. The main biological, physical, chemical, geological, and botanical forensic evidence (i.e., samples related to the actor of the crime and of investigative interest to be submitted to trial) may be individual or belong to a class. The individual forensic evidence may allow the identification of a person with an elevated degree of certitude (e.g., DNA and fingerprints). The class forensic evidence may allow the identification of a group of persons/objects (i.e., blood groups, glass, fibers, paper, plastics, hairs paints, soils, etc.) [2].

Geoforensics (or forensic geology) is a discipline that is 150 years old, and probably originated during the Roman empire period. In the historical criminological/criminalistic scenario, a few examples of worldwide mediatic serious crimes solved by forensic geologists may be related to cases of kidnapping and homicide of victims, as in the case of the honorable Aldo Moro (1978, Italy) [9,10] or the agent of the DEA (Drug Enforcement Administration) Enrique Camarena Salazar (1985, Mexico) [4], or cases of searches for MPFs, such as the terrorist Osama bin Laden (2001, Afghanistan) [11].

Forensic geology applies principles, methods, and techniques of the earth sciences to solve criminal cases [12–29]. These latter mostly concern crimes against human beings (homicides, kidnappings, sexual violence, robbery), animals, property (burglary, damaging), the environment (environmental disaster or pollution) [30–37], and counterterrorism [11]. In particular, in serious crimes that occur outdoors in the countryside, such as homicides or kidnappings, it is highly probable that useful info-investigative diversified data may be obtained, especially in investigations that aim to define the following:

1. Their pre—mortem presence on the scene.
2. Their walking route on the site.
3. The possible transfer of the victim's corpse in secondary crime scenes.
4. The modality of the victim's death.

The stratigraphical approach may be of paramount importance when micro-stratigraphic sequences on belongings of the suspects are recognized and sub-sampled. Several sequential layers of different soils/sediments may be recognized in the footwear or clothing of the actors of crimes. In particular, the grooves present on the footwear's soles may gather and preserve soil/sediment traces transferred from the top soil to the shoe, providing an ordered set of micro-layers where the oldest (the first one to transfer) is in contact with the sole and the youngest (the last to transfer) is the more external [2]. In such circumstances, the stratigraphy principle of superposition will assist in the reconstruction of the timing of the events [2].

The main forensic analyses and activities devoted to criminal cases may involve the following:

a. Comparative analyses and provenance studies, based on mineralogical, petrographic, sedimentological, paleontological, and geochemical investigations [38–54]. Forensic comparisons between two or multiple samples of geological and soil traces and micro-traces are aimed to ascertain whether they originated from different sources [51]. When specimens are found to be indistinguishable, the possibility that a single source is the provenance area of the samples cannot be excluded [51]. Such investigations may allow the actors of a crime (suspect and victim of a homicide) to be linked to the crime scene or the scene of events.
b. Mineralogical, geochemical, and paleontological analyses. These studies, also based on comparative analyses of geomaterials (such as gemstones, fossils, artworks) may allow the authenticity and provenance to be ascertained, as in the cases of frauds, product tampering, art crime, conflict minerals, and fossil fakes [51,55–59].
c. Remote sensing, geological, geochemical activities, together with geophysical shallow prospecting and applied geology investigations. These investigations [60–73], also based on comparative analyses, may allow the characterization of the environmental matrices (soil and water) and the related underground features in cases of environmental crimes. In particular, remote sensing surveys are carried out to locate MPFs, dens of terrorists, or, in general, illicit activities, using photos, ortho imaging, videos, and photograms, in visible, ultraviolet, and infrared spectra, and elaborated in GIS systems [61,62,64–70]. Such investigations may also be applied to depict and search for shallow clandestine gravesites and concealments [74–92].

The main comparative analytical methods are used to characterize composition, textures, and structures of the inorganic, organic, and anthropogenic components of the geological and soil forensic evidence (Table 1).

Forensic soils (and sediments) are usually composed of three different components:

The inorganic component (minerals and micro- to nano-fossils).

1. The organic component (vegetal and animal remains).
2. The anthropogenic component (manufactured materials such as glass, plastic, paper, and brick fragments).

The main parameters and characteristics investigated in the inorganic component may be synthesized as follows (Table 1):

1. Color.
2. Particle size.
3. Structure and texture.
4. Fossil content.
5. Mineralogy.
6. Chemical and chemical–physical composition.

The organic component, vegetal and animal, may be very abundant and important in the sample. Once identified, it must be separated by the geologist and submitted to the specialistic analyses of forensic botanists and entomologists, respectively. In particular, the finding of plant remains such as seeds, thorns, leaves, and pollens or their associations have been demonstrated to be very useful for linking forensic evidence to a specific environment of provenance and for dating the period of transferring the trace [10,93–99]. New advances in forensic biology on the vegetal DNA identification may demonstrate the transfer of a specific plant DNA to an actor of crime. Such a multi-disciplinary scientific approach on inorganic and organic forensic evidence based on standardized protocols [100] and procedures reported in the international scientific literature may provide very useful data, especially in crime scenes that occur in the countryside.

Table 1. Main methods and techniques usually applied for comparative analyses of geological forensic evidence in a laboratory. * Instruments also portable in the field.

Matrices	Methods and Techniques	Analyzed Characteristics
Geological samples	Spectrophotometers/Munsell charts/computational methods	Color
Geological samples	Mechanical sieve/Laser diffraction particle size analyzer/Coulter counter/particle size analyzer through automated microscopy and image analysis for measuring particle size and particle shape	Texture (grain size, morphology)
Geological samples	Optical microscopy (OM) using a stereo microscope *, in transmitted and reflected light, with tele camera and workstation for image analyses	Texture/Structure
Geological samples	Optical microscopy (OM) using a polarizing microscope, in transmitted and reflected light, with tele camera and workstation for image analyses	Mineral composition/Texture/Structure
Geological samples	Powder X-ray diffractometry (PXRD)	Mineral composition
Geological samples	Scanning electron microscopy with energy dispersion system (SEM—EDS)/quantitative evaluation of minerals via scanning electron microscopy (QUEMSCAN)	Composition/Texture/ Structure
Geological samples	Scanning electron microscopy (SEM)	Composition/Morphology
Geological samples	X-ray fluorescence (XRF) *	Elemental qualitative determination
Geological samples	µ—RAMAN spectroscopy */FTIR spectroscopy	Molecular qualitative determination
Geological samples	Inductively coupled plasma-mass spectrometry (ICP—MS)/inductively coupled plasma—optical emission spectroscopy (ICP—OES)/instrumental neutron activation analysis (INAA)	Elemental quantitative determination

The study of the geological forensic evidence may assist in establishing the degree of similarity among samples to associate or exclude a suspect to/from the victim and crime scene, by comparing the characteristics of the unknown samples with those of the known samples (field sample). On the basis of the above, it is evident that ascertaining the compatibility or similarity among geological and soil traces and micro-traces of unknown provenance (unknown sample), and soils and sediments of known provenance (known samples or field samples), may assume a fundamental role in the geoforensics investigations. Nonetheless, a simple compatibility among forensic specimens may not be decisive if not supported by strong geological, biological, physical, and chemical forensic evidence. As a matter of fact, in contrast to individual characteristics (DNA, fingerprints), the provided geological and soil forensic evidence having class characteristics [9] needs to be carefully investigated to obtain assessable data. To achieve a high probatory value of the forensic evidence presented to the court, the main task should be to gain the highest number of geological characteristics and peculiar particles [4] to compare.

If the wide range of compared characteristics provides forensic evidence that there is a match, or not, among compared forensic specimens, it is possible to link the actors of a crime to the criminal act, or, with a high level of probability exclude them from it, respectively, by ascertaining that the compared specimens possess features analogous to those of a specific microenvironment from which these may derive [19,23].

3. Criminal Casework

Although the presented criminal proceeding was archived, the author preferred to deal with the data and inferences described below by presenting MPFs/victims, samples, dates, sites, and infrastructures anonymously.

A few years ago, an Italian locality of the countryside was the sad scenario of a criminal case of presumed kidnapping, which was concluded after sometime with the finding of the human remains of two subjects. One day, the two persons left their home, and after a car accident, they quickly abandoned their car and belongings, departing the site. They disappeared into thin air, and nobody saw them in the surrounding areas. A few days after their disappearance, the two MPFs were found lifeless in two separate sites not too far from the site of the car accident (Figure 1). Victim 1 was found about 1.1 km away, as the crow flies, from the place of the last sighting (Figure 1), under an element of infrastructure, a few meters away. One shoe was found on the ground near the corpse, the other one in suspension attached to a shrub. The remains of victim 2 were approximately located at 0.5 km from the site of the car accident, halfway between it and the place where victim 1 was found (Figure 1). The body was found skeletonized and bones were found dispersed in an area (wide about 800 m^2) of the dense Mediterranean maquis.

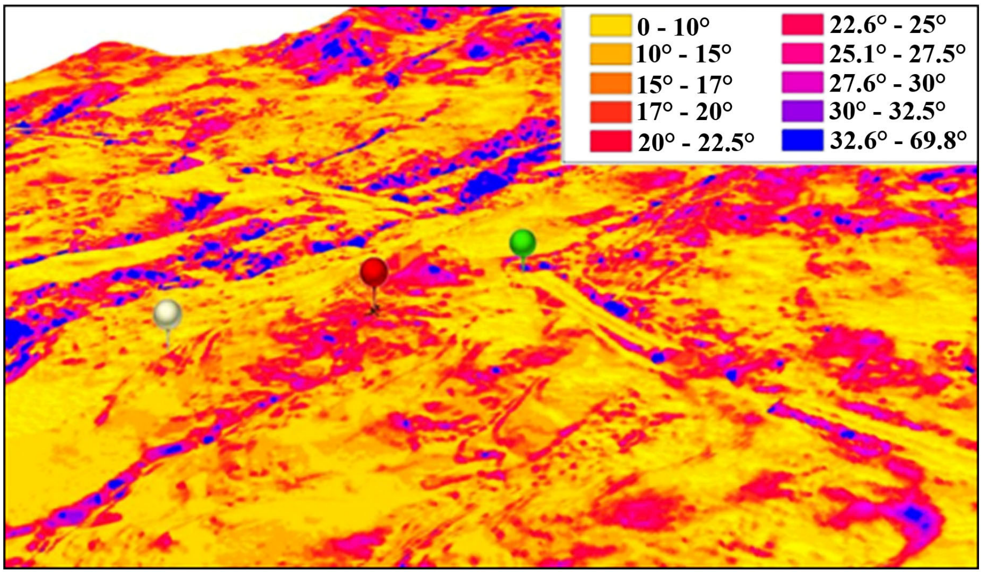

Figure 1. Three-dimensional model of the slope, elaborated in QGIS, showing the location of the car accident site (green sphere), the site at which victim 2 was found (red sphere), and the site where victim 1 was found (whitish sphere). Legend: Ranges of inclinations of the slope. Source: Author.

The shoes of victim 2 were found a few tens of meters from the remains, at a higher altitude.

The judicial authority instigated an impressive investigation, covering a wide spectrum of traditional and scientific investigations, inter- and trans-disciplinary, employing disciplines usually used for the 360° characterization of serious crimes that happen outdoors in the countryside, such as legal medicine, forensic pathology, odontology, entomology, toxicology, veterinary, psychiatry, engineering, computer science, physics, geology, and botany.

In particular, considering that the two MPFs were not carrying any mobile, GPS, or electronical devise, the judicial authority gave to the author the task of ascertaining the active pre—mortem presence of the two MPFs at the event site and to reconstruct the route walked by them, if possible.

4. Materials and Methods

Although geological traces are mostly provided having class characteristics, a sort of "fingerprint" of the specimens [101] may be identified by means of a careful examination of both peculiar and rare grains [4], minerals, composition, textural features, and peculiar assemblages of minerals and vegetal remains studied in both the unknown and known specimens to be compared. A clever expert should be able to carry out comparative analyses based on a wide range of parameters and characteristics.

With this in mind, the comparative analyses were performed tracing the "fingerprints" of both geological trace forensic evidence (related to the two MPFs and their belongings) and soils (related to the event scene and localities of investigative interest).

Geological trace forensic evidence (unknown samples) was sampled by searching for traces under a magnifying glass (10×, 20×, 30×) on the two cadavers during the autopsy, and successively on their belongings and skeletal remains using a stereomicroscope in a laboratory of forensic geology. Special attention was devoted to the footwear, which were in strict contact with the topsoil during the movement of the MPFs. Such contact, as stated by the Locard exchange principle, may allow an easy transfer of inorganic and organic (plant and small animal remains) particles from the topsoil to the footwear, linking in such a way the subject to a specific site [102,103].

The shoes of MPF 1 were found to be very dirty and scratched (Figure 2A,B), very rich in vegetal material (mostly seeds and thorns inside the shoes and fixed on the soles and laces, Figure 2C), and with inorganic traces (Figure 2C).

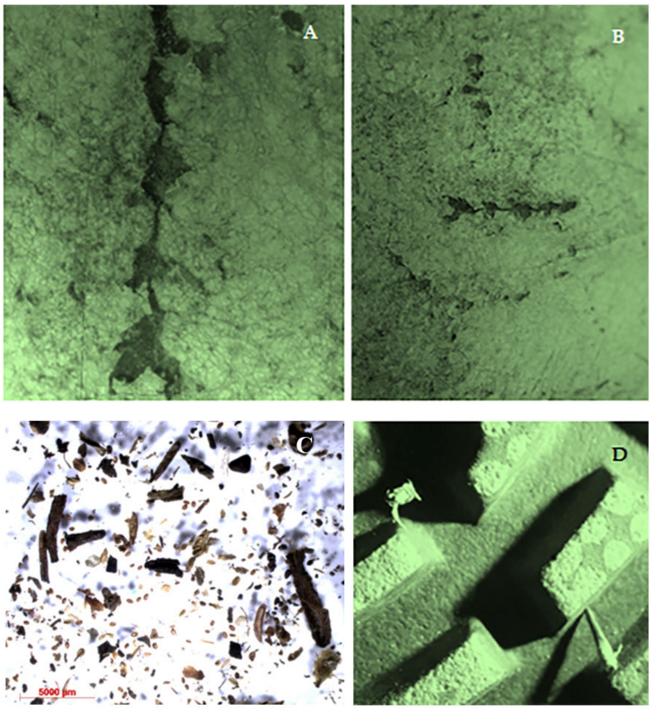

Figure 2. Microphotographs taken under a stereo-binocular microscope and reflected light. (**A**,**B**) Deep scratches of the leather of the upper part of the shoes of MPF 1, presumably due to the impact and abrasion of thorny plants during walking by the MPF 1. (**C**) Most common appearance of the questioned trace showing a very abundant vegetal component (*Erica arborea* leaves, capsules, and seeds, branches, thorns, and humus collected in the internal part of the shoes; see later), transferred to the inner part of MPF1's shoes during walking in a woody area. (**D**) Two thorns of *Cytisus infestus* fixed in the sole of MPF 2's shoes, transferred while MPF 2 walked at the scene of events. Plants determined by Fabio Mondello. Source: Author.

MPF 2's shoes were intact, in a pair, and with inorganic and vegetal traces (mostly thorns fixed on the soles).

Multiple pieces of soil forensic evidence (known specimens) were collected on the sites where the human remains were found (known samples), and the localities were trampled by the victims with the same footwear in the days immediately before the disappearance event, for exclusion purposes. With the same aim, footwear of the two MPFs were also sized to characterize the usual type of traces present.

A few hundreds samples were collected overall.

Multiple pieces of geological trace and soil forensic evidence were first analyzed under a stereomicroscope [4], as they were found. Field samples were treated, mechanically sieved, and separated. Particle size analysis (PSA) was carried out on field samples using the laser diffraction technique. Trace samples, due to their limited amount, were "virtually" separated on the base of the diameter by means of image analyses, after having taken microphotographs under a stereomicroscope. Different sub-samples on the basis of the grain size were obtained.

Optical analyses under a stereomicroscope and SEM-EDS, both provided at a workstation, were conducted to investigate the following main parameters and characteristics: color, coating, shape, habitus, luster, particle size, texture, fossil content, and mineralogy. Stubs of the samples with selected particles were prepared for the SEM-EDS forensic characterization, in order to investigate both morphological features at higher magnification and composition. Smear slides of the specimens were observed under a petrographic microscope for an expeditious characterization of mineralogy and fossil content. The different parameters and features were quantitatively characterized by counting each particle of the specimens (at least 100 particles for the sample) for the most widespread grain sizes. Particle morphometry was determined by means of image analysis software. The Riley sphericity ($\sqrt{\frac{Di}{Dc}}$) (*Di*: the diameter of the largest inscribed circle, *Dc*: the diameter of the smallest circumscribing circle) was applied for the two-dimensional sphericity measurement. The roundness was determined by means of comparative charts.

The protocols used for geological analyses conformed with those in Bourguignon et al. (2019) [100] and the international literature.

Botanical forensic evidence was collected by the author from the victims and their belongings, or separated from the geological trace forensic evidence. Vegetal elements were sampled on the plants growing on the sites of the events and other sites of investigative interest or separated from the soil forensic evidence. Morphological determinations on plants (including algae) were accomplished under a microscope by a team of experts in systematic botany.

Particle size analyses and separations were performed by using the following:

1. Mechanical sieve (AS 200 control model, Retsch, Düsseldorf, Germany) with sieves (meshes of 2000 μ, 1000 μ, 500 μ, 250 μ, 125 μ, 63 μ).
2. Laser diffraction granulometer (Mastersizer 2000, Malvern Panalytical Ltd, Malvern, UK) equipped a with wet dispersion unit and workstation (Figure 3A).
3. Motorized stereomicroscope equipped with a digital camera and workstation (SteREO Discovery V20, Carl Zeiss AG, Feldbach, Switzerland) (Figure 3B).

Analyses were performed on particles contained in Petri capsules, glass slides, smear slides, and stubs with carbon adhesive using the instruments having the following characteristics:

1. Stereomicroscope (Leica MZ 12, magnifications from 8× to 100×, Leica Microsystems, Wetzlar, Germany).
2. Motorized stereomicroscope with reflected and transmitted polarized light (Zeiss Stereo Discovery.V20, magnification from 3.8× to 530× with optical zoom) equipped with digital camera and workstation (Carl Zeiss AG, Feldbach, Switzerland).
3. Motorized petrographic optical microscope with reflected and transmitted polarized light (Zeiss Imager.M2m model, magnifications from 25× to 500×) equipped with tele camera and workstation (Carl Zeiss AG, Feldbach, Switzerland) (Figure 3B).

4. Optical microscope for biological use (Leitz Laborlux 12, magnifications from 40× to 1000×) equipped with 12 MP digital camera (Leitz GmbH & Co KG, Stuttgart, Germany).
5. SEM operating in low vacuum, chamber pressure of 50 Pa at 20.00 kV e (FEI QUANTA FEG 450 model) equipped with an Energy Dispersive System (X-ray analyzer, SEM-EDS, FEI, Hillsboro, OR, USA) and workstation (AMETEK, Berwyn, PA, USA) (Figure 3C).

Figure 3. Instrumentation. (**A**) Laser diffraction granulometer. (**B**). Workstation—Motorized stereomicroscope with reflected and transmitted polarized light (on the left), motorized petrographic optical microscope with reflected and transmitted polarized light (on the right), and workstation (in the center)—Forensic Geology laboratory, MIFT Department, University of Messina. (**C**) SEM equipped with EDS system and workstation—Laboratory of microscopic analyses, Engineering Department, University of Messina. Source: Author.

5. Results on the Comparative Analyses

5.1. Geological Forensic Evidence

Samples were found to comprise sandy to silty hyaline siliciclastic grains mainly composed of mono-mineral grains/clasts of quartz with different intensity yellow to orange Fe-coatings, minor opaque yellow ocher lithoclasts of quartzarenites, and microfossils (benthic and planktonic foraminifera).

Mineralogical, petrographic, and sedimentological examinations of the geological trace and soil forensic evidence revealed that these were mainly composed of an analogous mineral assemblage. Despite the mineralogical homogeneity, seven main classes of grain typologies were identified on the basis of different mineralogical and textural characteristics and parameters (luster, coating, color, shape, habitus, roundness, and sphericity) examined under a stereo-binocular reflected and transmitted light microscope and SEM-EDS.

The identified grain characteristics and parameters were described for each class. About one thousand medium-fine to very fine sandy grains were analyzed in the unknown samples as well as in the known samples (field samples), in the complex (Table 2, Figure 4).

Table 2. Characterization of the different types of grains identified in the forensic unknown and known samples of the casework.

Class ID	Description
ID01	Hyaline grains predominantly rounded and triangular in shape with yellow/orange coating, which gives the grains a hyaline appearance with more or less marked yellow/orange “spots” up to straw yellow/orange/reddish.
ID02	Rounded hyaline grains with evidence of the original crystalline habitus with yellow/orange coating, which gives the grains a hyaline appearance with more or less marked yellow/orange “spots” up to straw yellow/orange/reddish with minor percentage of sub-angular clasts.
ID03	Predominantly rounded and spherical hyaline grains without coating.
ID04	Hyaline grains with rounded tabular crystalline habitus and without coating.
ID05	Rare hyaline grains of smoky gray color and without coating.
ID06	Rounded and spherical hyaline clasts with yellow/orange coating, which gives the clasts a hyaline appearance with more or less marked yellow/orange “spots” up to straw yellow/orange/reddish with a smaller percentage of sub-angular and lamellar grains.
ID07	Opaque grains mainly yellow ocher and fossil forms (mainly benthic foraminifera) with a smaller percentage of opaque brown or light grains.

Grains appeared to be mostly rounded with a minor percentage of sub-angular clasts, whereas the Riley sphericity was found to be equal to 0.8 in both the unknown and known samples (field samples).

Additional comparisons, accomplished in order to exclude possible previous traces in the victims’ questioned samples, related to their staying with the same footwear in the sites visited in the days immediately before the tragic event. These allowed the absence to be ascertained of particles composed of mono- and polymineral assemblages of metamorphic rocks typical of the soils collected in these other locations of investigative interest.

Two (250–125 μ, 125–63 μ) and three (250–125 μ, 125–63 μ, <63 μ) grain sizes were identified as the most representative ones of both the unknown and known samples. The distribution of the quantitative data related to the seven class characteristics of the unknown and known samples, reported for both the 250–125 μ and the 125–63 μ grain sizes, showed optimal overlaps and trends (Figure 5). In particular, three main types of grains were prevalent in both unknown and known samples. These were, in order of abundance (Table 2, Figure 5):

i. ID06—Rounded and spherical hyaline clasts with yellow/orange coating with a percentage of sub-angular and lamellar grains.
ii. ID02—Rounded hyaline grains with evidence of the original crystalline habitus with yellow/orange coating.
iii. ID03—Rounded and spherical hyaline grains without coating.

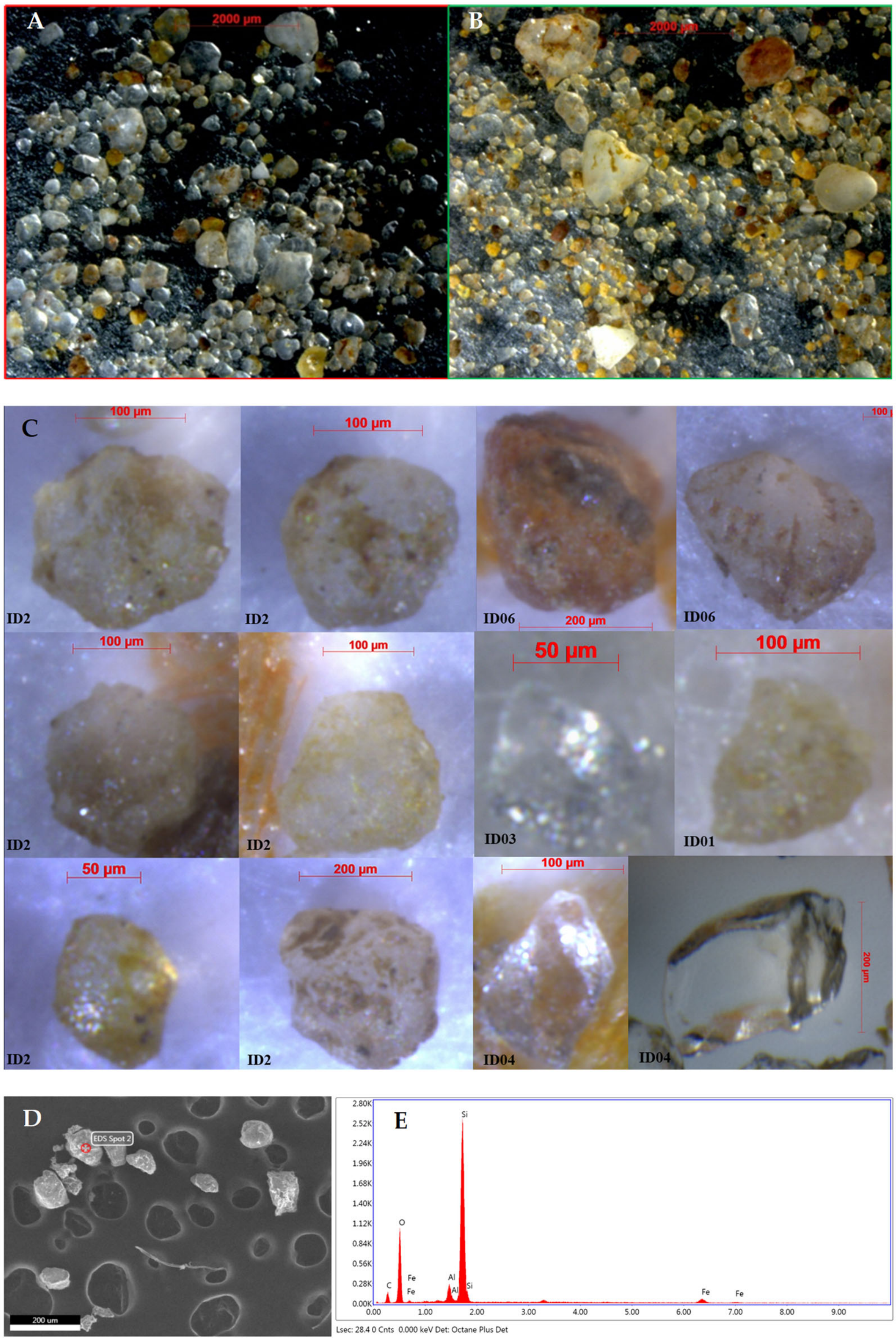

Figure 4. (**A**–**D**) Microphotographs taken under a stereo-binocular microscope with reflected light of sandy grains of quartz. (**A**) Unknown trace forensic evidence observed with a dark background. (**B**) Known forensic evidence observed with a dark background. (**C**) ID1–4 ID6 class grains of quartz observed with a mm-sized background. (**D**) SEM micrograph of unknown sample with ID02 type grain. (**E**) SEM-EDS spectrum of quartz grain with Fe coating spot 2 in (**D**). Source: Author.

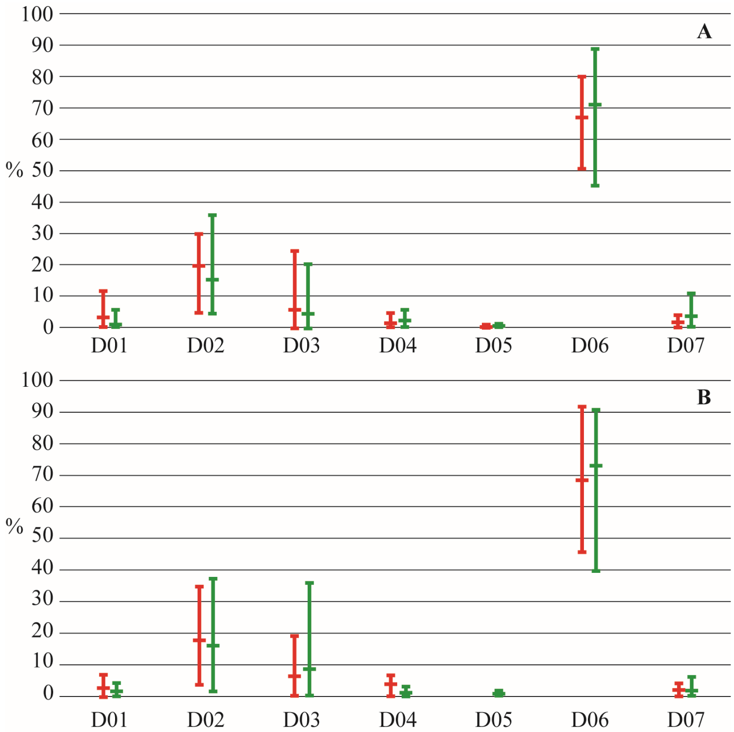

Figure 5. Comparisons of the percentages of the seven grain type characteristics (D01–D07) recognized in hundreds of unknown (red line) and known (green line) samples (from the event sites), reported for the 250–125 μm grain size (**A**) and the 125–63 μm grain size (**B**). Minimum, medium, and maximum values (horizontal traits) are also shown. Source: Author.

5.2. Botanical Forensic Evidence

Forensic botany was applied for the present casework in order to corroborate the forensic geology investigations. The amount of the vegetal material prevailed on the inorganic grains. The vegetal fraction separated from the geological traces related to the unknown samples from the MPFs and their belongings, and observed via stereomicroscopy, microscopy, and SEM-EDS, was found to be composed of plant fragments or entire elements of branches, twigs, leaves, thorns, capsules, fruits, seeds, pollen, herbaceous fragments, wood, vegetable debris, decomposing organic material (humus), and algae (including diatoms).

The main 12 species of remnants of traces of the identified terrestrial plants were as follows [98]:

1. *Erica arborea* (leaves, capsules, seeds).
2. *Quercus suber* (leaves, flowers, seeds).
3. *Olea europaea* (leaves, seeds).
4. *Cistus monspeliensis* (leaves, seeds, capsules, etc.).
5. *Pistacia lentiscus* (leaves, seeds).
6. *Myrtus communis* (leaves, seeds).
7. *Cytisus infestus* (branches, legume, thorns).
8. *Smilax aspera* (leaves, thorns).
9. *Rosa sempervirens* (thorns).
10. *Rubus ulmifolius* (thorns).
11. *Rosacea Amygdaloidea* (thorns).
12. *Cynara cardunculus* (thorns).

Peculiar particles were considered the thorns and seeds, which were the most abundant vegetal component sampled on bodies, clothing, and footwears of both MPFs.

Over 522 seeds of *Erica arborea* and 81 thorns ascribable to *Rosa sempervirens*, *Rubus ulmifolius*, *Rosacea amygdaloidea*, *Cynara cardunculus*, *Cytisus infestus*, and *Smilax aspera* were found in the shoes of victim 1, mostly inside the shoes and planted on the soles, respectively. Another peculiar material was represented by an aggregate made up of remnants of freshwater algae found in the sole of victim 1's footwear [98].

Only 16 thorns ascribable to *Rosa sempervirens* or *Rubus ulmifolius*, *Cynara cardunculus*, *Cytisus infestus*, and *Smilax aspera* were found on the soles of the shoes of victim 2. No traces of algae were found, except a unique diatom [97,98].

The same 12 species of terrestrial plants reported above were also found in the vegetation present at the sites of the events and in the vegetal component of the soils collected from this area.

On the basis of the above, four main macro-areas with different botanical characteristics were distinguished during remote sensing and field work. The identified macro-areas were as follows [98]:

1. Shrub formation with Mediterranean maquis (prevailing macro area).
2. Area inside the highway perimeter.
3. Meadow area with anthropic pressure from pasture with some puddles of freshwater with algae.
4. Tree formation dominated by Sughera (*Quercus suber* L.), with a circumscribed zone showing abundant concentration of *Erica arborea* shrub wood and soils rich in fresh to decomposed seeds of *Erica arborea* (about 6000 seeds of *Erica arborea* were examined and counted in the soils).

5.3. Tracking the Route Walked by the Two MPFs

During investigations, great attention was also devoted to the specific search for rare or peculiar particles or assemblages of inorganic and vegetal origin. This examination allowed the unknown samples collected on the victim belongings to be recognized:

1. Rare particles of calcite and dolomite.
2. Peculiar compositions of clay minerals rich in calcium phosphate.
3. Peculiar assemblages of different classes of mineral grains.
4. Vegetal remains of mm-sized thorns of *Cynara cardunculus* and *Rosa sempervirens*, seeds of *Erica arborea*, and assemblages of algae.

The same rare and peculiar materials were also recognized in some specific sites of the scene of events, as specified in the following. Geobotanic data on the unknown samples were found to be typical of microenvironments very similar to those identified at the scene of events. These results were of paramount importance in allowing investigators and the judicial authority to link the MPFs to specific sites of the scene of events and in tracking the routes of both the MPFs, which were obtained from nine specific microenvironments recognized at the scene of events.

Figure 6 and Table 3 illustrate the sequence and distribution of the match points and match linear belts (M), from which the path was delineated by means of interpolation of matching sites and four exit/entry points (E1–4), recognized in the event scene during field work, starting from the site of the car accident site (CA). The locations of the two different sites at which the human remains were found (F1 and F2) were also reported.

Table 3. Sites selected for linking MPFs to the event sites and reconstructing the route walked by them.

MPFs/Victims	Acronyms	Typology of Sites for Linking MPFs to Event Site
MPF 1–MPF 2	CA	Car accident site (Route start point)
MPF 1	M1	Match point (inorganic traces)
MPF 1–MPF 2	M2	Match linear belt (organic traces)
MPF 1–MPF 2	E1	Exit (rudimental wood gate)
MPF 1	M3	Match point (organic traces)

Table 3. *Cont.*

MPFs/Victims	Acronyms	Typology of Sites for Linking MPFs to Event Site
MPF 1–MPF 2	M4	Match point (inorganic traces)
MPF 1–MPF 2	M5	Match point (inorganic traces)
MPF 1–MPF 2	E2	Exit (rudimental wood gate)
MPF 2	M6	Match point (inorganic traces)
MPF 1–MPF 2	E3	Entry (hole in the barber wire perimeter)
MPF 1	M7	Match linear belt (organic traces)
MPF 1	M8	Match point (inorganic traces)
Victim 2	F2	Finding site of skeletonized human remains
MPF 1	E4	Exit (hole in the barber wire perimeter)
MPF 1	M9	Match point (organic traces)
Victim 1	F1	Finding site of human remains (Route end point)

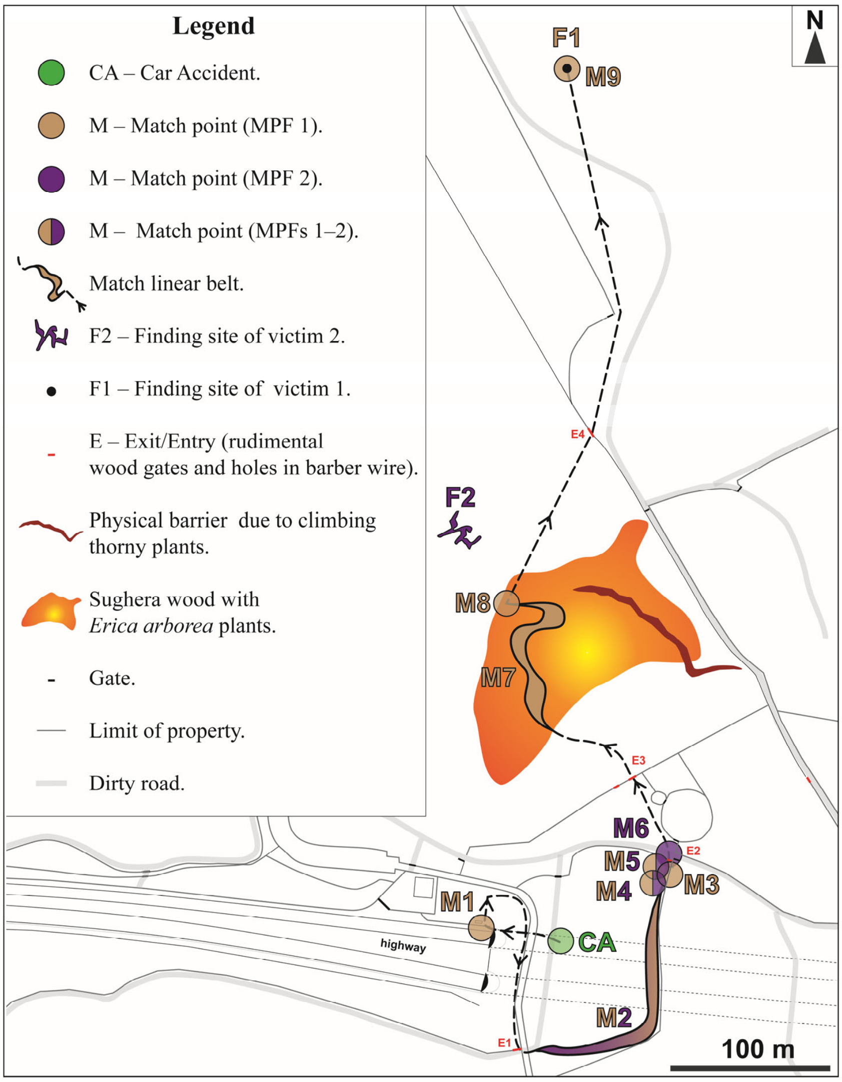

Figure 6. Route walked by the two MPFs at the scene of events. The route was reconstructed by interpolating the starting point of the car accident (CA) with the nine match points and linear belts (M), and the exit/entry sites (E). Source: Author.

5.3.1. Car Accident (Table 3, Figure 6)

The two subjects abandoned the site of the car accident, which occurred inside a tunnel of the highway.

5.3.2. Match Point 1 (M1) (Table 3, Figure 6)

Inorganic micro-traces (calcite) from MPF 1's ring.

These micro-traces were comparable with the calcareous composition of the top of a ~1 m high perimeter wall delimiting the lateral gate of the highway (Figure 7).

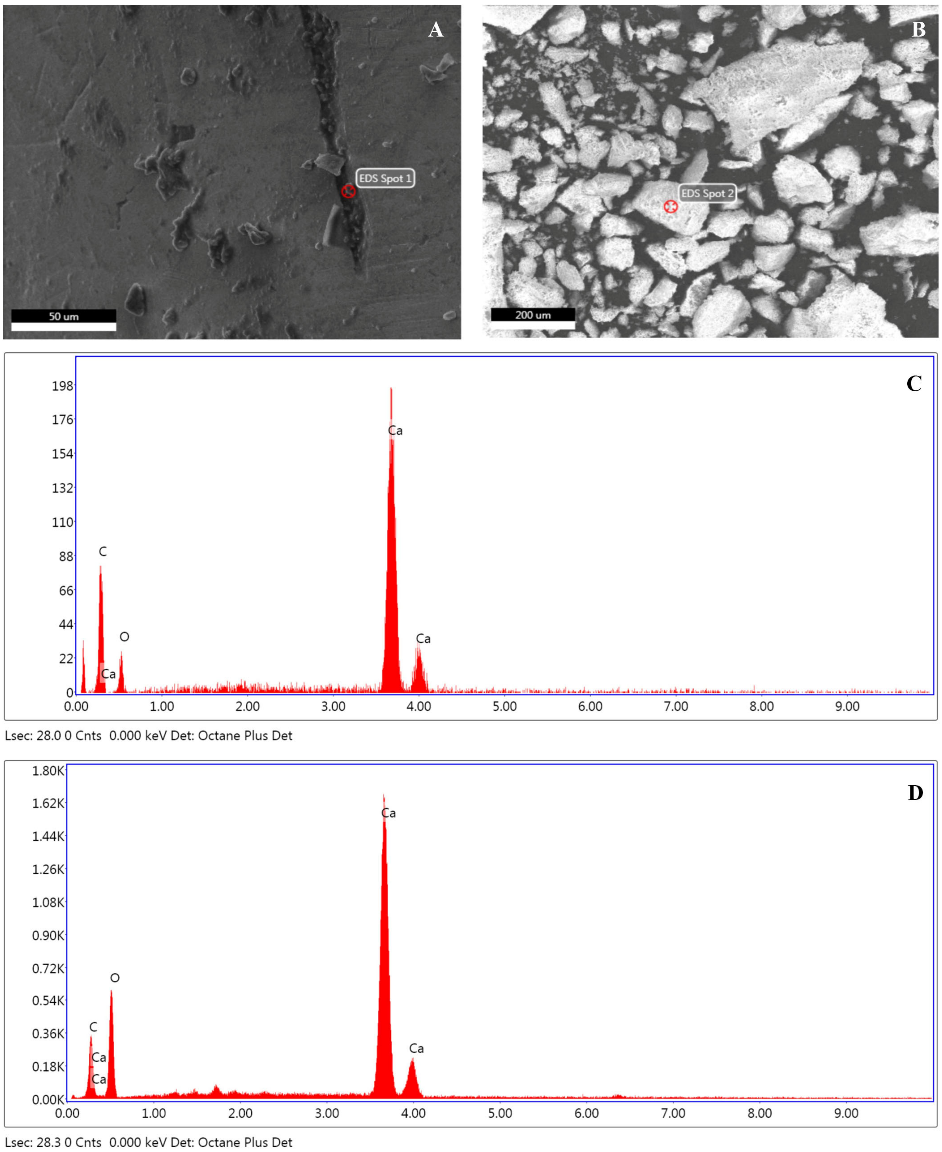

Figure 7. (**A**) SEM micrograph of calcite traces in a groove on the gold ring of MPF 1. (**B**) SEM micrograph of calcium carbonate fragments scraped from the upper part of the wall. (**C**) X-ray microanalysis (SEM–EDS) compatible with calcium carbonate from the traces (spot 1 in (**A**). (**D**) X-ray microanalysis (SEM–EDS) compatible with calcium carbonate from the fragments (spot 12 in (**B**) (M1 in Figure 6). Source: Author.

5.3.3. Exit (E1) (Table 3, Figure 6)

The two MPFs passed through a rudimentary wood gate delimiting the area surrounding the highway tunnels.

5.3.4. Match Linear Belt 2 (M2) (Table 3, Figure 6)

Organic traces (thorns of *Cynara cardunculus*) from MPF 1's sock and MPF 2's shoes.

This forensic evidence was comparable with some thorny plants growing on an uncultivated field in the meadow area with anthropic pressure from pasture (Figure 8).

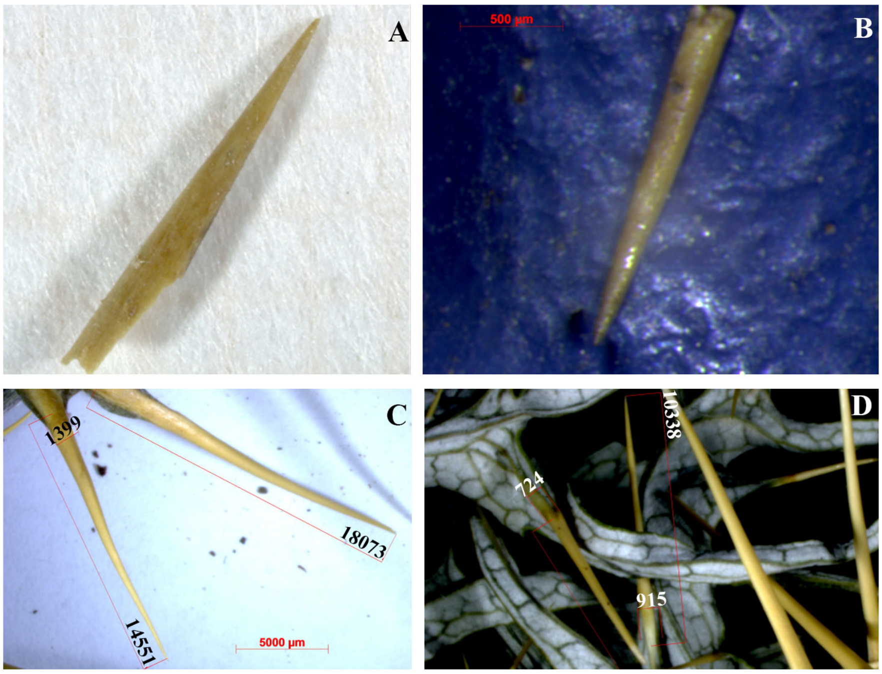

Figure 8. Microphotographs taken under a stereo-binocular microscope and reflected light of *Cynara cardunculus*. (**A**) Thorn from the sock of MPF1. (**B**) Thorn extracted from the sole of the shoe of MPF 2. The hole in the sole is observable near the indicated termination. (**C**) Thorns collected from a plant at the event site. (**D**) Thorns and leaves collected from a plant at the event site (M2 in Figure 6). Measures are in µm. Plants determined by Fabio Mondello. Source: Author.

5.3.5. Match Point 3 (M3) (Table 3, Figure 6)

Organic traces (algae) from MPF 1's shoes.

These were comparable with algae present in fresh water of a muddy puddle (Figure 9).

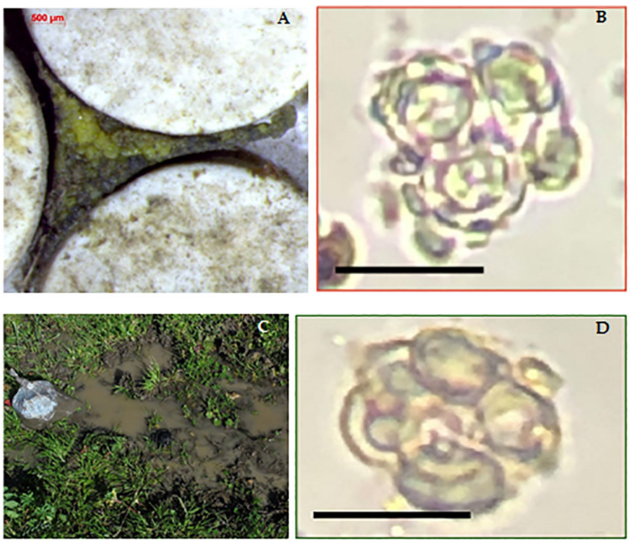

Figure 9. (**A**) Algae and soil aggregate imbedded in the space among adjacent circular cleats on the soles of the shoes observed under a stereo-binocular microscope with reflected light. (**B**) *Chlorellales*

or *Chlamydomonadales* (*Chlorophyta*) from the aggregate of (**A**) observed under a microscope. (**C**) Puddle with fresh water at the scene of events. (**D**) *Chlorellales* or *Chlamydomonadales* (*Chlorophyta*) from the puddle with fresh water of (**C**) (M3 in Figure 6). Scale bar: 100 µm. Algae determined by Marina Morabito. Source: Author.

5.3.6. Match Point 4 (M4) (Table 3, Figure 6)

Inorganic micro-traces of P-rich clays from MPFs' shoes.

These were comparable with wet soil present on the muddy puddle reported above (Figure 10).

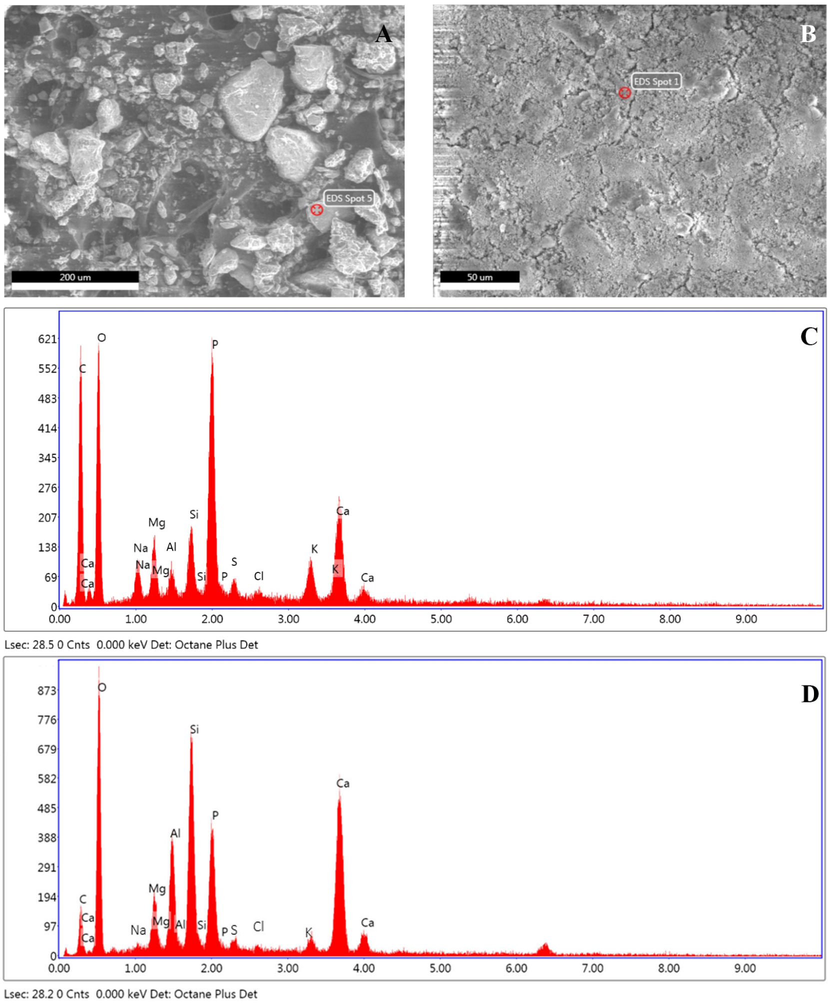

Figure 10. (**A**) SEM micrograph image of P–rich clayey minerals from MPF 1's shoes (unknown sample). (**B**) SEM micrograph image of P–rich clayey soil from a puddle at the event scene. (**C**,**D**) X-ray microanalyses (SEM–EDS) related to P–rich clayey minerals (spot 3 in (**A**,**C**)) and soil (**B**,**D**) (M4—spot 1 in Figure 6). Source: Author.

5.3.7. Match Point 5 (M5) (Table 3, Figure 6)

Inorganic traces from MPF 2's shoes.

This particle assemblage was comparable with the sandy and silty soil present in a specific site of an uncultivated field in the meadow area with anthropic pressure from pasture (Figure 11).

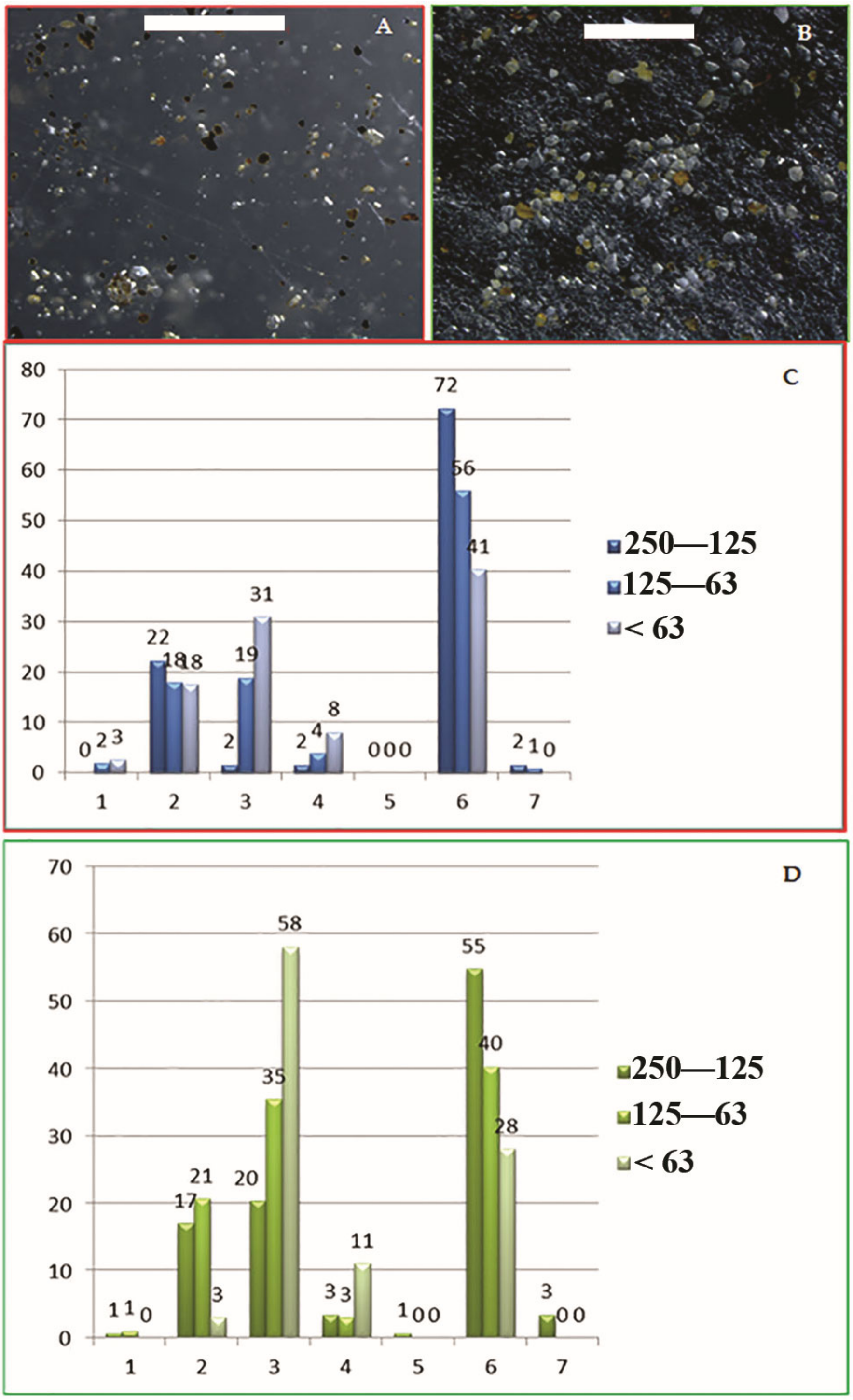

Figure 11. (**A**) Sandy grains from MPF 2's shoes (unknown sample) under a stereomicroscope. (**B**) Sandy grains from a soil sample (unknown sample) from the event scene under a stereomicroscope. Scale bar: 2000 µm. (**C**,**D**) Comparative analyses (sieve size is expressed in µm). Histograms of the seven grain types related to the percentages of the sandy grains from MPF 2's shoes (in (**A**,**C**)) and the soil (**B**,**D**) (M5 in Figure 6). Source: Author.

5.3.8. Exit Point (E2) (Table 3, Figure 6)

The two MPFs passed through a rudimentary wood gate delimiting an uncultivated field in the meadow area with anthropic pressure from pasture.

5.3.9. Match Point 6 (M6) (Table 3, Figure 6)

Inorganic traces (dolomite) from MPF 2's shoes (Figure 12A).

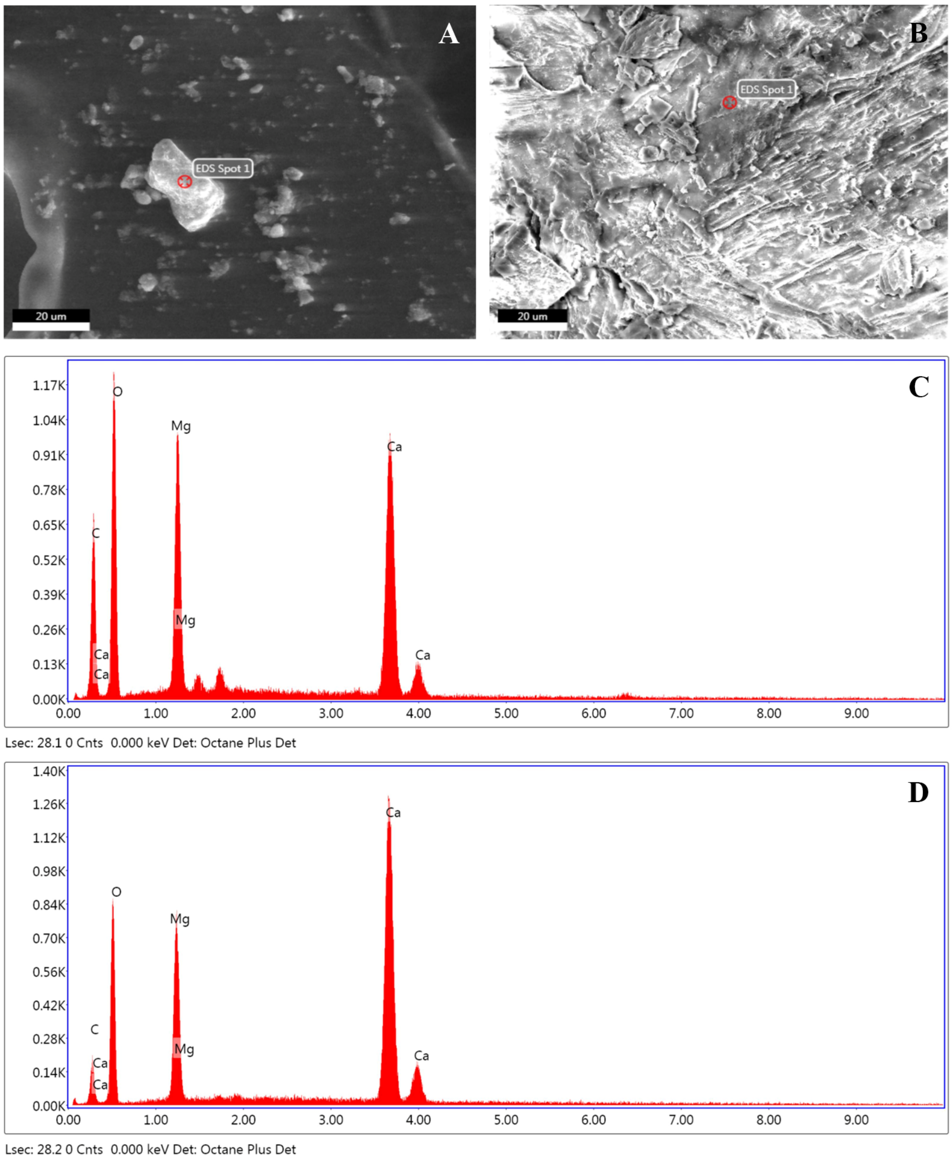

Figure 12. (**A**) SEM micrograph image of dolomitic clast from MPF 2's shoes (unknown sample). (**B**) Microphotograph under a stereomicroscope of clast of pinkish dolostone (known sample) from a dirty road at the event scene. (**C**,**D**) X–ray microanalyses (SEM–EDS) of dolomite minerals from MPF 2's shoes (**C**) and dolostone from the event scene (**D**) (M6 in Figure 6). Source: Author.

These were comparable with clasts of pinkish dolostones artificially reported on a dirt road present on an uncultivated field, near a wood rudimentary gate (Figure 12B).

5.3.10. Entry Point (E3) (Table 3, Figure 6)

The two MPFs passed through a passage in the barbed wire delimiting the Sughera wood with *Erica arborea* plants, and entered this area.

5.3.11. Match Linear Belt 7 (M7) (Table 3, Figure 6)

Organic traces (*Erica arborea* seeds) from MPF 1's shoes (Figure 13) and socks.

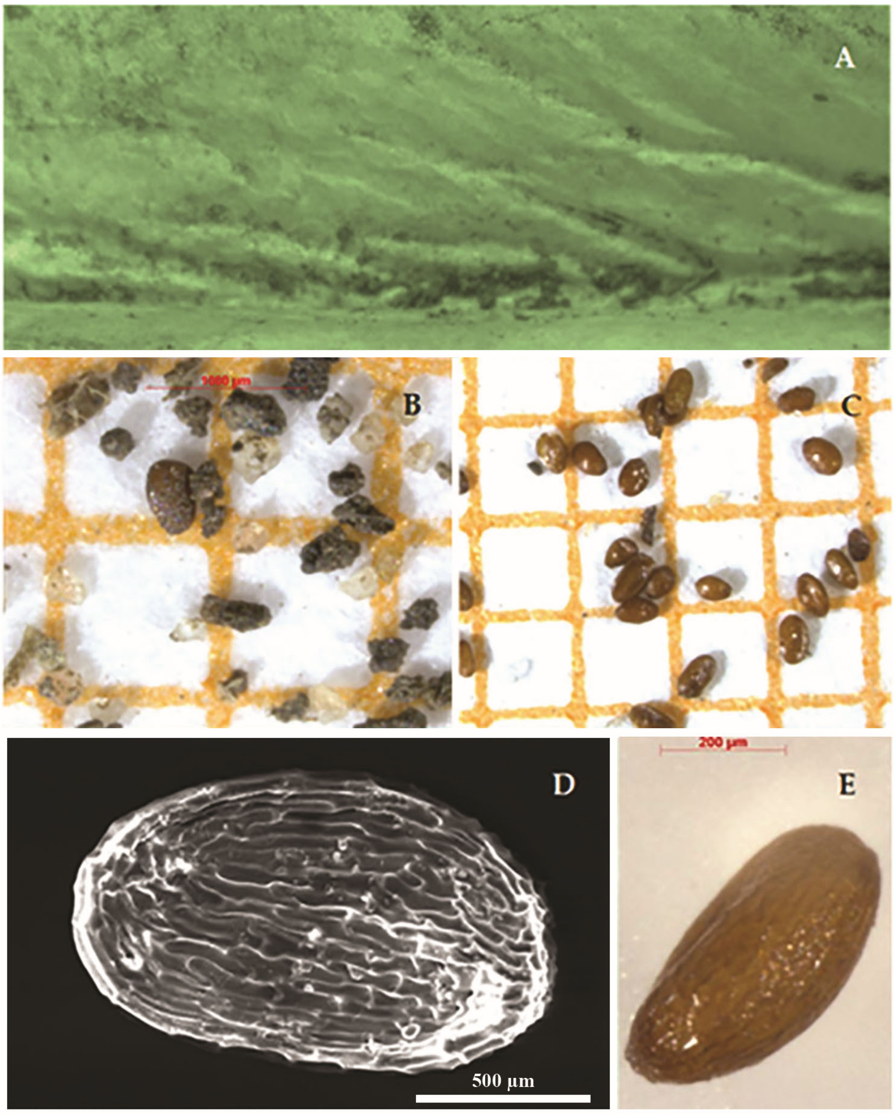

Figure 13. (**A**) Dirty internal side of the upper part of MPF 1's shoes showing geological forensic evidence with a very abundant vegetal component made up of *Erica arborea* seeds (unknown sample), transferred to the shoes during the walking of MPF 1 in the Sughera woody area with *Erica arborea*. (**B**) *Erica arborea* seeds and humus from victim 1's shoes (unknown sample), under a stereomicroscope. (**C**) *Erica arborea* seeds separated from a soil sample (known sample) from the Sughera woody area with *Erica arborea*, under a stereomicroscope. (**D**) SEM micrograph of an *Erica arborea* seed (**C**). (**E**) Seed of *Erica arborea*, under a stereomicroscope (**D**). (M7 in Figure 6). *Erica arborea* determined by Fabio Mondello and Angelo Troia. Source: Author.

The freshness state of the *Erica arborea* seeds in MPF 1's shoes (Figure 13A) was comparable with that of seeds present in the soil in the wood with Sughera (*Quercus suber* L.) and associated with *Erica arborea* shrubs, as cited above (Figure 13).

5.3.12. Match Point 8 (M8) (Table 3, Figure 6)

Inorganic traces from MPF 1's shoes.

This particle assemblage was comparable with the sandy and silty soil present in the area of the wood with Sughera (*Quercus suber* L.) and *Erica arborea* shrubs (Figure 14).

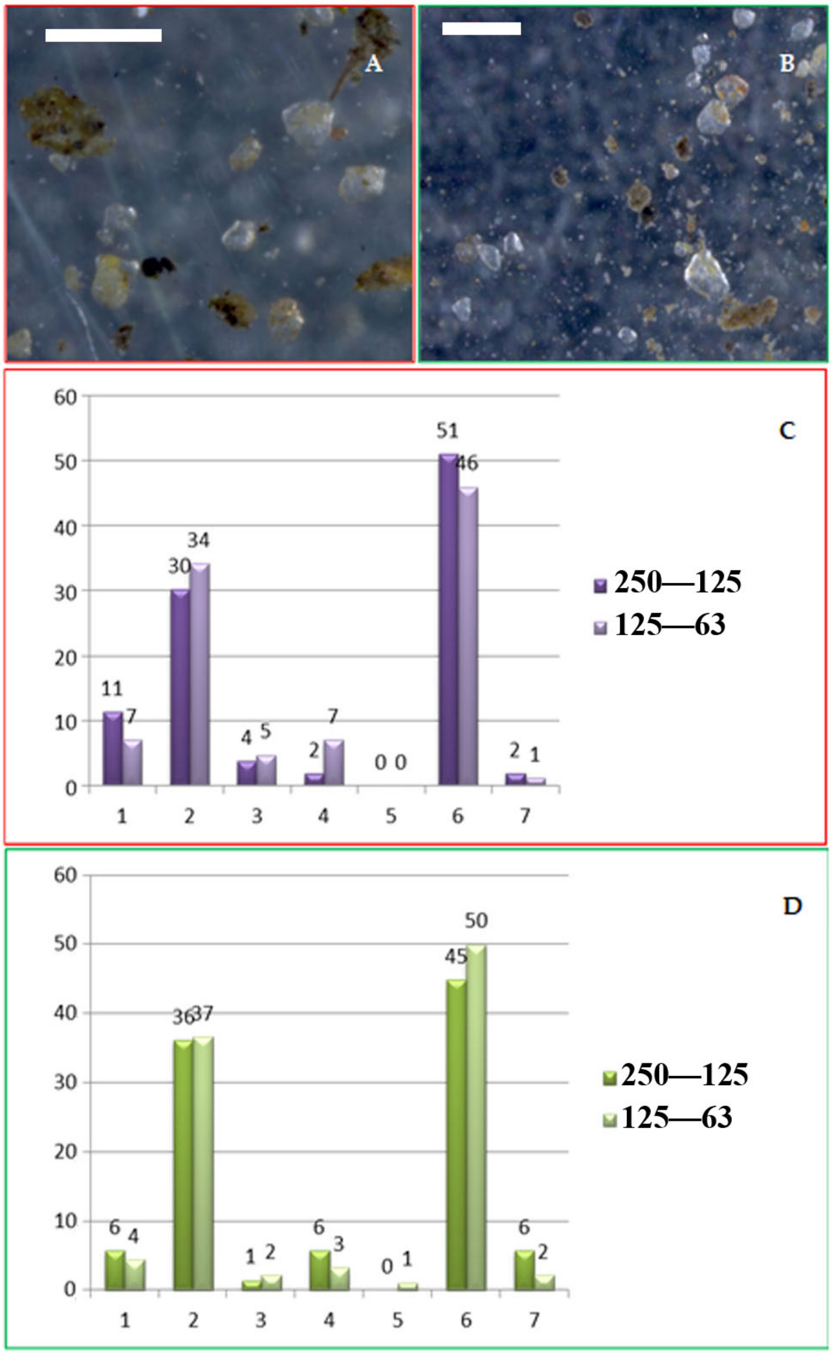

Figure 14. (**A**) Sandy grains from MPF 1's shoes (unknown sample) under a stereomicroscope. (**B**) Sandy grains from a soil sample (unknown sample) from the event scene under a stereomicroscope. Scale bar: 500 µm. (**C**,**D**) Comparative analyses (sieve size is expressed in µm). Histograms of the seven grain types related to the percentages of the sandy grains from MPF 1's shoes (in (**A**,**C**)) and the soil (**B**,**D**) (M8 in Figure 6). Source: Author.

5.3.13. Finding Site (F2) (Table 3, Figure 6)

The skeletonized human remains of victim 2 were found distributed in an articulated area of the dense Mediterranean maquis.

5.3.14. Exit (E4) (Table 3, Figure 6)

MPF 1 passed through a passage in the barbed wire delimiting the Sughera wood with *Erica arborea* plants, thus abandoning this area.

5.3.15. Match Point 9 (M9) (Table 3, Figure 6)

Organic traces (*Rosa sempervirens* thorns) from MPF 1's shoes, socks, and clothing.

These traces were comparable with the thorns of the climbing *Rosa sempervirens* plants growing on the infrastructure in proximity of the site at which the corpse was found (Figure 15).

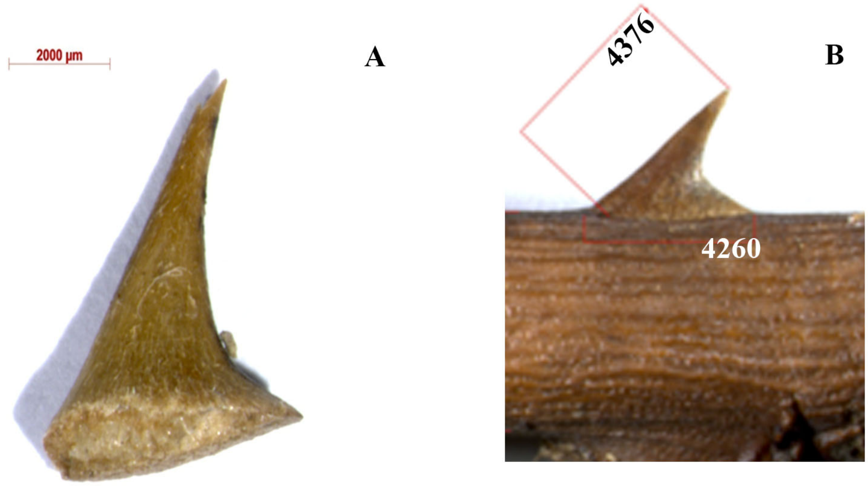

Figure 15. (**A**) Thorn of *Rosa sempervirens* L. caught in the lace of MPF 1's shoes (at the bottom left). (**B**) Thorn of *Rosa sempervirens* L. (**A**), under a stereomicroscope. Measures are in µm. Plants determined by Fabio Mondello. Source: Author.

5.3.16. Finding Site (F1) (Table 3, Figure 6)

The body of MPF 1 was found under an element if infrastructure in a prone position.

6. Discussion and Conclusions

Finally, it seems appropriate in this discussion to underline some considerations related to the criminal investigations.

In the USA, the geological evidence in a trial for the kidnapping, sexual violence, and murder of a 9-year-old girl led the jury and the judge to condemn the criminal, with a sentence of the death penalty [50]. In Italy, although the criminal law is different, it cannot be considered a minor responsibility to limit the personal liberty of a suspect. A proper background knowledge in forensic sciences is an opportune requirement that each expert should take care to have before accepting any forensic charge. The knowledge of base concepts in both criminalistics (crime scene analysis and legal medicine) and criminology (forensic psychiatry and psychology, criminal law, investigations, and intelligence) is of paramount importance in forensics in order to have a complete setting of the case and to limit possible procedural errors. The familiarity in these matters may have an influence by contributing to the positive results of investigations.

During each one of the judicial inspections made at the crime scenes or event scenes, the expert may benefit from forensic sciences expertise. The use of the investigative empathy and the knowledge of the psychological background of the victims or suspects may help ensure that no hypotheses are ignored. In cases such as that presented here, a central aspect of field work is to walk, several times, every possible path at the event sites. To quantify the physical efforts and difficulties involved in crossing shrubs, infrastructures, and narrow passages; to walk with the same models of shoes and clothing of the victims; to search for all possible exit–entry passages; to study the slope, meteorology, and ephemeris conditions at the time of the event; and, last but not least, to see the scene of events with the eyes of the victims, may be actions that are fundamental to directing investigations, discarding certain hypotheses, and strengthening the obtained results.

On the other hand, the multi-disciplinary approach presented here allowed experts in geology and botany to work in a team in the field, and, at different times or jointly, on the same samples in the same laboratory. This work organization, although analyses were particularly time consuming, allowed the amount of time required for the conclusion of the forensic investigations and the submission of the report to the judicial authority to be significantly reduced.

The wide spectrum of mineralogical, morphological, morphoscopic, textural, and geobotanic determinations accomplished for the present criminal casework allowed a general high degree of compatibility to be ascertained among traces sampled on the MPFs and field samples collected at the scene of events, and the exclusion of possible previous traces related to their staying with the same footwear at other sites in the days immediately before the tragic event.

These comparative analyses provided fundamental info-investigative data of paramount importance for establishing the active pre–mortem presence of the MPFs at the scene, and to deal with a criminal case for which other methods were not very useful and inapplicable. No–one saw the MPFs walking in the countryside, the MPFs were not carrying any mobiles, GPS, or technological devices, and no tele cameras were at the scene.

The most significant positive matches, based on the finding of ten peculiar and rare particles and assemblages, allowed the reconstruction of a very detailed walking path, of about 1.1 km long, as the crow flies, that was carried out by the two MPFs on the event site.

As a matter of fact, the finding of ten different points and linear belts having a positive match, from 1 (near the car accident site) to 9 (the site at which victim 1 was found), allowed the reconstruction and tracking of the route walked by the two MPFs in the hours immediately preceding their death (Table 3, Figure 6). The inferences obtained by data interpretations were very useful for the judicial system. A few criminological and criminalistic inferences based on the investigations, carried out in the laboratory and the field, allowed us to hypothesize that:

1. After the car accident (CA, Figure 6) on the highway, the two subjects abandoned their vehicle and walked out of the tunnel, reaching a lateral gate beside the highway. They presumably ran away to hide themselves in the countryside.
2. The transfer of calcite particles from the perimeter wall of the highway to the ring (M1, Figure 6) happened when MPF 1 passed on wall, touching it with their hands, in order to reach the raised ground behind the highway.
3. A first exit (E1, Figure 6) allowed the two MPFs to walk off the highway.
4. The transfer of thorns of *Cynara cardunculus* to MPF 1's sock and MPF 2's shoes (M2, Figure 6) occurred when the subjects walked on these thorny plants distributed in a linear belt.
5. The transfer of algae from a freshwater puddle to the soles of MPF 1's shoes (M3, Figure 6) happened when the subject walked in this specific puddle.
6. The transfer of P-rich clay from wet soil to the soles of the two MPF's shoes (M4) occurred when they walked in the wet area.
7. The transfer of the sandy and silty soil from a specific site to MPF 2's shoes (M5, Figure 6) happened when the MPF walked in this locality.
8. A second exit (E2, Figure 6) allowed the two MPFs to walk from the meadow area, which was subject to anthropic pressure from pasture.
9. The transfer of dolomite clasts to MPF 2's shoes from a dirt road (M6, Figure 6), in front of E2, occurred when the victim walked on this road.
10. A third passage (E3, Figure 6) allowed the MPFs to enter a Sughera wood with *Erica arborea* plants. This locality was covered and isolated, and suitable for hiding effectively.
11. The transfer of over 522 seeds of *Erica arborea* from plants and soils present in the wood to the internal parts of shoes and socks of MPF 1 occurred when the victim walked in this area (N7, Figure 6). It may be presumed that the transfer of the seeds occurred when the thick *Erica arborea* seed-rich soil, and seeds that had fallen from the *Erica arborea* shrubs due to the impact of the body with them, filled the internal parts of the shoes.

12. The transfer of a peculiar mineral particle assemblage to MPF 1's shoes (M8, Figure 6) happened when the MPF 1 passed through this area.
13. This site (M8) was very close to the site (F2, Figure 6) at which the skeletonized human remains of victim 2 were found.
14. A fourth passage (E4, Figure 6) allowed MPF 1 to leave the woody area and reach a dirt road.
15. The transfer of *Rosa sempervirens* thorns from the infrastructure to MPF 1's shoes, socks, and clothing (M9 in Figure 6) presumably occurred when the subject climbed on this structure.
16. The prone position of MPF 1's body at the site at which it was found (F1, Figure 6), its distance from the infrastructure, as well as its relationships with the plants present on the ground unequivocally supported the reconstruction of the manner of death of MPF 1, for causation, as ascertained by the medico legal investigations. In particular, some injuries on the body could be due to the dynamic impact of the body that occurred on the plants growing on the ground.

In synthesis, geobotanic investigations allowed the following to be established:

1. Both MPFs actively interacted with the microenvironments recognized at the scene of events in the match sites M1–M9 (Figure 6), as requested by the judicial authority.
2. Both MPFs actively walked at the scene of events along a specific route in areas with different degrees of vegetation density and difficulty of passing through (Figure 6).
3. MPF 2 walked a shorter path than MGF 1; this path was reconstructed from the car accident site (CA, Figure 6), to the dirty path with detritus of dolostones (M6, Figure 6). It may be hypothesized that MPF 2 was carried out in MPF 1's arms in the Sughera woody area that contained *Erica arborea*, from the surrounding of the M6 site to the M8 site, i.e., in an area immediately next to the site at which victim 2 was found (F2, Figure 6). This inference was consequent to the fact that no seeds of *Erica arborea* were found in the footwear of MPF 2 (notwithstanding adhesive material in the shoes), whereas hundreds of seeds of *Erica arborea* were found in the socks and footwear of MPF 1.
4. MPF 1 walked a longer path than MPF 2 to the site where the body was found (F1, Figure 6).
5. MPF 1 actively climbed on the infrastructure (M9, Figure 6).

In conclusion, the peculiar and rare grains, minerals, composition, and textures, together with the peculiar and rare assemblages analyzed in the unknown and known specimens from the victims and the event scene, permitted the identification of a "fingerprint" of most of the examined specimens. Most of these fingerprints were obtained by means of image analysis and the manual counting of grain characteristics. This procedure, although extremely time consuming and relevant only in cases after the finding of the MPF, was of utmost importance in strengthening the reconstructions proposed here. In such a way, investigators were able to provide very strong geological forensic evidence to support criminal investigations. The used approach was of utmost importance in strengthening the proposed inferences, where other methods could not provide any information.

The approach used to track the route walked by the two MPFs could be contrasted with the strategies used to combat the Al-Qaeda terrorism. When a terrorist is captured in the countryside, it may be useful or necessary to trace the route walked by him/her, to search for a terrorist den or a site of investigative interest (burial of firearms, explosives, etc.).

Despite these encouraging and promising results, and the great potential of this method, in Italy forensic geology still represents a minor discipline of the forensic sciences [104]. In the Italian police criminal laboratories, the analysis of geological traces actually rarely occurs, in contrast to the realities of other countries (Federal Bureau of Investigation (FBI) Laboratory of Trace Evidence, Quantico, USA [51,105]; Institute of Criminalistics (ICP), Prague, Czech Republic [106,107]; Australia [50]). Mediatic cases of kidnappings and homicide, as in the case of the Italian honorable Aldo Moro or in the case presented here (whose approach was inspired by the Moro case) were solved using the application of earth science disciplines. At present, after almost half a century, geologists are not involved in the police forces in Italy. This circumstance, anomalous with respect to what occurs in other countries, induces prosecutors, magistrates, and judges to contact geologists, chosen among freelances or academics, to assist them in such criminal investigations [2], thereby imposing a burden on the State's economic resources.

On the basis of the above, for the next generations of forensic experts in geology, it should be desirable that academics and researchers undertake the following:

1. Open a channel of dialogue and technical–scientific discussions with the Ministries of Justice, Defense, and Interior.
2. Further implement scientific and didactic initiatives on forensic geology [108–113].
3. Promote initiatives for introducing the master's degree in geology in police applications for employing geologists/forensic examiners for the police forensic bureau (*Carabinieri*, police).
4. Develop forensic protocols envisaging all possible technical procedures/operations to be accurately applied at the crime or event scene to preserve forensic evidence made of inorganic and organic materials, and strengthen greater interaction and collaboration between forensic geologists, botanists, and experts in legal medicine directly at the crime scene, in order to arrange all the activities aimed at preserving these traces as far as possible, even during necropsy operations.

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Conflicts of Interest: The author declares no conflict of interest.

References

1. Nilson, M.T.; Marks, S.; Meer, T. Manhunting: A Methodology for Finding Persons of National Interest. Ph.D. Thesis, Naval Postgraduate School, Monterey, CA, USA, 2005.
2. Somma, R. Unraveling crimes with geosciences. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–23. [CrossRef]
3. Richards, J. *Intelligence and Counterterrorism*; Routledge: New York, NY, USA, 2018.
4. Murray, R.C. *Evidence from the Earth: Forensic Geology and Criminal Investigation*; Mountain Press Publishing Company: Missoula, MT, USA, 2004; p. 226.
5. Murray, R.C. Forensic geology: Yesterday, today and tomorrow. *Geol. Soc. Spec. Publ.* **2004**, *232*, 7–9. [CrossRef]
6. Murray, R.C.; Tedrow, J.C. *Forensic Geology: Earth Sciences and Criminal Investigation*; Rutgers University Press Address: Piscataway, NJ, USA, 1975; p. 232.
7. Pirrie, D.; Dawson, L.; Graham, G. Predictive geolocation: Forensic soil analysis for provenance determination. *Episodes* **2017**, *40*, 141–147. [CrossRef]
8. Intini, A.; Picozzi, M. *Scienze Forensi. Teoria e Prassi Dell'investigazione Scientifica*; UTET Giuridica Publisher: Milano, Italy, 2009; p. 544, ISBN 8859803977.
9. Saferstein, R. *Criminalistics: An Introduction to Forensic Science*; Pearcon: London, UK, 2017; ISBN 978-0134477596.
10. Lombardi, G. The contribution of forensic geology and other trace evidence analysis to the investigation of the killing of Italian Prime Minister Aldo Moro. *J. Forensic Sci.* **1999**, *44*, 634–642. [CrossRef] [PubMed]
11. Shroder, J.J. Remote Sensing and GIS as Counterterrorism Tools for Homeland Security: The case of Afghanistan. In *Geospatial Technologies and Homeland Security*; Sui, D.Z., Ed.; The GeoJournal Library; Springer: Dordrecht, The Netherlands, 2008; Volume 94. [CrossRef]
12. Tindall, C.G. Forensic Geology. *Soil Sci.* **1994**, *157*, 128. [CrossRef]

13. Pye, K.; Croft, D.J. (Eds.) *Forensic Geoscience: Principles, Techniques and Applications*; Geological Society, Special Publications: London, UK, 2004; p. 232.
14. Pye, K. Forensic geology. In *Encyclopedia of Geology*; Selley, R.C., Cocks, L.R.M., Plimer, I.R., Eds.; Elsevier Ltd.: Oxford, UK; Amsterdam, The Netherlands, 2005; Volume 2, pp. 261–273.
15. Ruffell, A.; McKinley, J. Forensic Geology & Geoscience. *Earth-Sci. Rev.* **2005**, *69*, 235–247. [CrossRef]
16. Morgan, R.M.; Wiltshire, P.E.J.; Parker, A.; Bull, P. The role of forensic geoscience in wildlife crime detection. *Forensic Sci. Int.* **2006**, *162*, 152–162. [CrossRef]
17. Morgan, R.M.; Bull, P.A. Forensic geoscience and crime detection. *Minerva Med.* **2007**, *127*, 73–89.
18. Pye, K. *Geological and Soil Evidence*, 1st ed.; CRC Press: Boca Raton, FL, USA; Oxford, UK, 2007; p. 356. [CrossRef]
19. Ruffell, A.; McKinley, J. *Geoforensics*; John Wiley & Sons Ltd.: Hoboken, NJ, USA, 2008; p. 332.
20. Fitzpatrick, R.W.; Raven, M.D.; Forrester, S.T. A systematic approach to soil forensics: Criminal case studies involving transference from crime scene to forensic evidence. In *Criminal and Environmental Soil Forensics*; Springer Science & Business Media B.V.: Dordrecht, The Netherlands, 2009; pp. 105–127.
21. Pirrie, D. Forensic geology in serious crime investigation. *Geol. Today* **2009**, *25*, 188–192. [CrossRef]
22. Ruffell, A. Forensic pedology, forensic geology, forensic geoscience, geoforensics and soil forensics. *Forensic Sci. Int.* **2010**, *202*, 9–12. [CrossRef]
23. Di Maggio, R.M.; Barone, P.M.; Pettinelli, E.; Mattei, E.; Lauro, S.E.; Banchelli, A. *Geologia Forense. Geoscienze e Indagini Giudiziarie*, 1st ed.; Dario Flaccovio Editore: Palermo, Italy, 2013; p. 319.
24. Sangwan, P.; Nain, T.; Singal, K.; Hooda, N.; Sharma, N. Soil as a tool of revelation in forensic science: A review. *Anal. Methods* **2020**, *12*, 5150–5159. [CrossRef] [PubMed]
25. Donnelly, L.J.; Pirrie, D.; Harrison, M.; Ruffell, A.; Dawson, L.A. (Eds.) *A Guide to Forensic Geology*, 1st ed.; The Geological Society: London, UK, 2021; p. 217.
26. Fitzpatrick, R.W.; Donnelly, L.J. An introduction to forensic soil science and forensic geology: A synthesis. *Geol. Soc. Spec. Publ.* **2021**, *492*, 1–32. [CrossRef]
27. Somma, R.; Maniscalco, R. Forensic geology applied to criminal investigation: A case report. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–18. [CrossRef]
28. Somma, R.; Trombino, L. Introducing Advances and applications in Geoforensics: Unraveling crimes with Geology. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–9. [CrossRef]
29. Spoto, S.E.; Barone, S.; Somma, R. An introduction to forensic geosciences. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–12. [CrossRef]
30. Oivanki, S.M. Forensic geology: Geologic investigation as a tool for enforcement of environmental regulations. *Miss. Geol.* **1996**, *17*, 45–63.
31. Ritz, K.; Dawson, L.A.; Miller, D. *Criminal and Environmental Soil Forensics*; Springer: Berlin/Heidelberg, Germany, 2009; p. 519. [CrossRef]
32. Ruffell, A.; Dawson, L. Forensic geology in environmental crime: Illegal waste movement & burial in Northern Ireland. *Environ. Forensics* **2009**, *10*, 208–213. [CrossRef]
33. Ruffell, A.; Kulessa, B. Application of geophysical techniques in identifying illegally buried toxic waste. *Environ. Forensics* **2009**, *10*, 196–207. [CrossRef]
34. Pirrie, D.; Ruffell, A.; Dawson, L.A. Environmental and criminal geoforensics: An introduction. *Geol. Soc. Spec. Publ.* **2013**, *384*, 1–7. [CrossRef]
35. Ruffell, A. Soil and drift geology in forensic investigations. In *Environmental and Criminal Geoforensics: An Introduction*; Pirrie, D., Ruffell, A., Dawson, L.A., Eds.; Geological Society: London, UK, 2013; Volume 384, pp. 163–172. [CrossRef]
36. Ruffell, A.; Pringle, J.K.; Graham, C.; Langton, M.; Jones, G.M. Geophysical assessment of illegally buried toxic waste for a legal enquiry: A case study in Northern Ireland (UK). *Environ. Forensics* **2018**, *19*, 239–252. [CrossRef]
37. Ruffell, A.; Barry, L. The desktop study an essential element of geoforensic search: Homicide and environmental cases (west Belfast, Northern Ireland, UK). *Geol. Soc. Spec. Publ.* **2021**, *492*, 39–53. [CrossRef]
38. Locard, R. The analysis of dust traces. *Rev. Int. Crim.* **1929**, *1*, 4–5.
39. Graves, W.J. A Mineralogical Soil Classification Technique for the Forensic Scientist. *J. Forensic Sci.* **1979**, *24*, 323–338. [CrossRef]
40. Palenik, S. Microscopic trace evidence—The overlooked clue. Part III Max Frei–Sherlock Holmes with microscope. *Microscope* **1982**, *30*, 93–100.
41. Sugita, R.; Marumo, Y. Validity of color examination for forensic soil identification. *Forensic Sci. Int.* **1996**, *83*, 201–210. [CrossRef]
42. Pirrie, D.; Butcher, A.R.; Power, M.R.; Gottlieb, P.; Miller, G.L. Rapid quantitative mineral and phase analysis using automated scanning electron microscopy (QemSCAN); potential applications in forensic geoscience. In *Forensic Geoscience: Principles, Techniques and Applications*; Pye, K., Croft, D.J., Eds.; Geological Society, Special Publications: London, UK, 2004; pp. 123–136.
43. Ruffell, A.; Wiltshire, P. Conjunctive use of quantitative and qualitative X-ray diffraction analysis of soils and rocks for forensic analysis. *Forensic Sci. Int.* **2004**, *145*, 13–23. [CrossRef]
44. Bull, P.A.; Morgan, R.M.; Dunkerley, S. SEM-EDS analysis and discrimination of forensic soil by Cengiz et al., A comment. *Forensic Sci. Int.* **2005**, *155*, 222–224. [CrossRef]

45. Morgan, R.M.; Bull, P.A. Data interpretation in forensic sediment and soil geochemistry. *Environ. Forensics* **2006**, *7*, 325–334. [CrossRef]
46. McKinley, J.; Ruffell, A. Contemporaneous spatial sampling at scenes of crime: Advantages and disadvantages. *Forensic Sci. Int.* **2007**, *172*, 196–202. [CrossRef]
47. Morgan, R.M.; Bull, P.A. The philosophy, nature and practice of forensic sediment analysis. *Prog. Phys. Geogr.* **2007**, *31*, 43–58. [CrossRef]
48. Fitzpatrick, R.W. Nature, Distribution, and Origin of Soil Materials in the Forensic Comparison of Soils. In *Soil Analysis in Forensic Taphonomy: Chemical and Biological Effects of Buried Human Remains*; Tibbett, M., Carter, D., Eds.; CRC Press: Boca Raton, FL, USA, 2008. [CrossRef]
49. Ruffell, A.; Sandiford, A. Maximising trace soil evidence: An improved recovery method developed during investigation of a $26 million bank robbery. *Forensic Sci. Int.* **2011**, *209*, e1–e7. [CrossRef] [PubMed]
50. Fitzpatrick, R.W.; Raven, M.D. How Pedology and Mineralogy Helped Solve a Double Murder Case: Using Forensics to Inspire Future Generations of Soil Scientists. *Soil Horiz.* **2012**, *53*, 14. [CrossRef]
51. Webb, J.B.; Bottrell, M.; Stern, L.A.; Saginor, I. Geology of the FBI lab and the challenge to the admissibility of forensic geology in US court. *Episodes* **2017**, *40*, 118–119. [CrossRef]
52. Fitzpatrick, R.W. Soil: Forensic Analysis. In *Wiley Encyclopedia of Forensic Science*; An Introduction to Forensic Soil Science and Forensic Geology: A Synthesis; Fitzpatrick, R.W., Donnelly, L.J., Eds.; Geological Society: London, UK, 2021; Volume 492, pp. 1–32. [CrossRef]
53. Somma, R. A multidisciplinary approach based on the cooperation of forensic geologists, botanists, and engineers: Computed Axial Tomography applied to a case work. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–10. [CrossRef]
54. Somma, R.; Spoto, S.E.; Raffaele, M.; Salmeri, F. Measuring color techniques for forensic comparative analyses of geological evidence. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–16. [CrossRef]
55. Ruffell, A.; Majury, N.; Brooks, W.E. Geological fakes and frauds. *Earth-Sci. Rev.* **2012**, *111*, 224–231. [CrossRef]
56. Barume, B.; Naeher, U.; Ruppen, D.; Schütte, P. Conflict minerals (3TG): Mining production, applications and recycling. *Curr. Opin. Green Sustain. Chem.* **2016**, *1*, 8–12. [CrossRef]
57. Ruffell, A.; Schneck, B. International case studies in forensic geology: Fakes and frauds, homicides and environmental crime. *Episodes Int. J. Geosci.* **2017**, *40*, 172–175. [CrossRef]
58. Marra, A.C.; Di Silvestro, G.; Somma, R. Palaeontology applied to criminal investigation. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–16. [CrossRef]
59. Spoto, S.E. Illicit trafficking of diamonds: New frontiers. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–9. [CrossRef]
60. Davenport, G.C. Remote sensing applications in forensic investigations. *Hist. Archaeol.* **2001**, *35*, 87–100. [CrossRef]
61. Manhein, M.H.; Listi, G.A.; Leitner, M. The application of geographic information systems and spatial analysis to assess dumped and subsequently scattered human remains. *J. Forensic Sci.* **2006**, *51*, 469–474. [CrossRef] [PubMed]
62. Herrmann, N.P.; Devlin, J.B. Assessment of commingled human remains using a GIS-based approach. In *Recovery, Analysis, and Identification of Commingled Human Remains*; Adams, B.J., Byrd, J.E., Eds.; Humana Press Publisher: Totowa, NJ, USA, 2008; pp. 257–270.
63. Donnelly, L.; Harrison, M. Geomorphological and geoforensic interpretation of maps, aerial imagery, conditions of diggability and the colour-coded RAG prioritization system in searches for criminal burials. *Geol. Soc. Spec. Publ.* **2013**, *384*, 173–194. [CrossRef]
64. Elmes, G.A.; Roedl, G.; Conley, J. (Eds.) *Forensic GIS: The Role of Geospatial Technologies for Investigating Crime and Providing Evidence*; Springer Press Publisher: Dordrecht, The Netherlands, 2014; p. 320.
65. Ruffell, A.; McAllister, S. A RAG system for the management forensic and archaeological searches of burial grounds. *Int. J. Archaeol.* **2015**, *3*, 1–8. [CrossRef]
66. Bunch, A.W.; Kim, M.; Brunelli, R. Under our nose: The use of GIS technology and case notes to focus search efforts. *J. Forensic Sci.* **2017**, *62*, 92–98. [CrossRef]
67. Somma, R.; Cascio, M.; Silvestro, M.; Torre, E. A GIS-based quantitative approach for the search of clandestine graves, Italy. *J. Forensic Sci.* **2018**, *63*, 882–898. [CrossRef]
68. Somma, R.; Costa, N. Unraveling Crimes with Geology: As Geological and Geographical Evidence Related to Clandestine Graves May Assist the Judicial System. *Geosciences* **2022**, *12*, 339. [CrossRef]
69. Somma, R. The space and time dimensions in the criminal behaviour of lust murderers. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–36. [CrossRef]
70. Somma, R.; Costa, N. GIS-based RAG-coded search priority scenarios for predictive maps to prevent future serial serious crimes: The case study of the Florence Monster. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–17. [CrossRef]
71. Wolff, M.; Asche, H. Towards geovisual analysis of crime scenes—A 3D crime mapping approach. In *Advances in GIScience*; Sester, M., Bernard, L., Paelke, V., Eds.; Springer: Berlin/Heidelberg, Germany, 2009; pp. 429–448. [CrossRef]

72. Baldino, G.; Ventura Spagnolo, E.; Fodale, V.; Pennisi, C.; Mondello, C.; Altadonna, A.; Raffaele, M.; Salmeri, F.; Somma, R.; Asmundo, A.; et al. The application of 3D virtual models in the judicial inspection of indoor and outdoor crime scenes. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–21. [CrossRef]
73. Somma, R.; Altadonna, A.; Cucinotta, F.; Raffaele, M.; Salmeri, F.; Baldino, G.; Ventura Spagnolo, E.; Sapienza, D. The technologies of Laser Scanning and Structured Blue Light Scanning applied to criminal investigation: Case studies. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–18. [CrossRef]
74. France, D.L.; Griffin, T.J.; Swanburg, J.G.; Lindemann, J.W.; Davenport, G.C.; Trammell, V.; Travis, C.T.; Kondratieff, B.; Nelson, A.; Castellano, K.; et al. Necrosearch revisited: Further multidisciplinary approaches to the detection of clandestine graves. In *Forensic Taphonomy: The Postmortem Fate of Human Remains*; Haglund, W.D., Sorg, M.H., Eds.; CRC Press Publisher: New York, NY, USA, 1997; pp. 497–509. [CrossRef]
75. Ruffell, A.; Wilson, J. Shallow ground investigation using radiometrics and spectral gamma-ray data. *Archaeol. Prospect.* **1998**, *5*, 203–215. [CrossRef]
76. Ruffell, A. Remote detection and identification of organic remains. *Archaeol. Prospect.* **2002**, *9*, 115–122. [CrossRef]
77. Ruffell, A. Burial location using cheap and reliable quantitative probe measurements. Diversity in forensic anthropology. *Spec. Publ. Forensic Sci. Int.* **2004**, *151*, 207–211. [CrossRef]
78. Ruffell, A. Searching for the I.R.A. Disappeared: Ground-penetrating radar investigation of a churchyard burial site, Northern Ireland. *J. Forensic Sci.* **2005**, *50*, 414–424. [CrossRef]
79. Salsarola, D.; Cattaneo, C. Archeologia forense. In *Scienze Forensi–Teoria e Prassi Dell'investigazione Scientifica*; Intini, A., Picozzi, M., Eds.; UTET Giuridica Publisher: Milano, Italy, 2009; pp. 207–226.
80. Pringle, J.K.; Jervis, J.R. Electrical resistivity survey to search for a recent clandestine burial of a homicide victim, UK. *Forensic Sci. Int.* **2010**, *202*, e1–e7. [CrossRef]
81. Harrison, M. Grave concerns, locating and unearthing human bodies. Aust. *J. Forensic Sci.* **2011**, *43*, 324–325. [CrossRef]
82. Larson, D.O.; Vass, A.A.; Wise, M. Advanced scientific methods and procedures in the forensic investigation of clandestine graves. *J. Contemp. Crim. Justice* **2011**, *27*, 149–182. [CrossRef]
83. Pringle, J.K.; Ruffell, A.; Jervis, J.R.; Donnelly, L.; McKinley, J.; Hansen, J.; Morgan, R.; Pirrie, D.; Harrison, M. The use of geoscience methods for terrestrial forensic searches. *Earth-Sci. Rev.* **2012**, *114*, 108–123. [CrossRef]
84. Sagripanti, G.L.; Villalba, D.; Aguilera, D.; Giaccardi, A. Advances of forensic geology in Argentina: Search with non-invasive methods for victims of enforced disappearance. *Bol. Geol.* **2017**, *39*, 55–69. [CrossRef]
85. López Batista, M.; Rodríguez López, S.; Fieguth Batista, A. The Use of GIS in Forensic Archaeology to Search Clandestine Graves in Uruguay. *Sci. Technol. Archaeol. Res.* **2018**, *2*, 61–74. [CrossRef]
86. Kamaluddin, M.R.; Mahat, N.A.; Mat Saat, G.A.; Othman, A.; Anthony, I.L.; Kumar, S.; Wahab, S.; Meyappan, S.; Rathakrishnan, B.; Ibrahim, F. The Psychology of Murder Concealment Acts. *Int. J. Environ. Res. Public Health* **2021**, *18*, 3113. [CrossRef] [PubMed]
87. Rocke, B.; Ruffell, A.; Donnelly, L. Drone aerial imagery for the simulation of a neonate burial based on the geoforensic search strategy (GSS). *J. Forensic Sci.* **2021**, *66*, 1506–1519. [CrossRef] [PubMed]
88. Rocke, B.; Ruffell, A. Detection of Single Burials Using Multispectral Drone Data: Three Case Studies. *J. Forensic Sci.* **2022**, *2*, 72–87. [CrossRef]
89. Byrd, H.J.; Sutton, L. The Use of Forensic Entomology within Clandestine Gravesite Investigations. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–13. [CrossRef]
90. Somma, R.; Sutton, L.; Byrd, J.H. Forensic geology applied to the search for homicide graves. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–20. [CrossRef]
91. Tagliabue, G.; Masseroli, A.; Ern, S.I.E.; Comolli, R.; Tambone, F.; Cattaneo, C.; Trombino, L. The Fate of Phosphorus in Experimental Burials: Chemical and Ultramicroscopic Characterization and Environmental Control of Its Persistency. *Geosciences* **2023**, *13*, 24. [CrossRef]
92. Tagliabue, G.; Masseroli, A.; Mattia, M.; Sala, C.; Belgiovine, E.; Capuzzo, D.; Galimberti, P.; Slavazzi, F.; Cattaneo, C.; Trombino, L. Thanatogenic Anthrosols: A geoforensic approach to the exploration of the Sepolcreto of the Ca' Granda (Milan). *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–21. [CrossRef]
93. Brown, A.G. The use of forensic botany and geology in war crimes investigations in NE Bosnia. *Forensic Sci. Int.* **2006**, *163*, 204–210. [CrossRef]
94. Jones, G.D.; Bryant, V.M. A comparison of pollen counts: Light versus scanning electron microscopy. *Grana* **2007**, *46*, 20–33. [CrossRef]
95. Caccianiga, M.; Bottacin, S.; Cattaneo, C. Vegetation Dynamics as a Tool for Detecting Clandestine Graves. *J. Forensic Sci.* **2012**, *57*, 983–988. [CrossRef] [PubMed]
96. Scott, K.R.; Morgan, R.M.; Jones, V.J.; Cameron, N.G. The transferability of diatoms to clothing and the methods appropriate for their collection and analysis in forensic geoscience. *Forensic Sci. Int.* **2014**, *241*, 127–137. [CrossRef] [PubMed]
97. Morabito, M.; Somma, R. The crucial role of Forensic Botany in the solution of judicial cases. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–16. [CrossRef]
98. Morabito, M.; Mondello, F.; Somma, R. Macrobotanic data implementing Forensic Geology investigations. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–15. [CrossRef]

99. Somma, R.; Cascio, M.; Cucinotta, F.; Mondello, F.; Morabito, M. Recent advances in forensic geology and botany for the reconstruction of event dynamics in outdoor crime scenes: A case study. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–21. [CrossRef]
100. Bourguignon, L.; Hellmann, A.; Marlof, A.; Fernadez Rodriquez, A.; Repele, M.; Utehaag, S.; Dawson, L.; Best Practice Manual for the Forensic Comparison of Soil Traces. Best Practise Manual, ENFI-BPM-APS-02, Version 1, December 2019. Available online: https://enfsi.eu/wp-content/uploads/2017/06/ENFSI_BPM_APST_Soil_Examination-vs1.0.pdf (accessed on 1 August 2023).
101. Bull, P.A.; Morgan, R.M. Sediment fingerprints: A forensic technique using quartz sand grains. *Sci. Justice* **2006**, *46*, 64–68. [CrossRef]
102. Croft, D.J.; Pye, K.A. Multi-technique comparison of source and primary transfer soil samples: An experimental investigation. *Sci. Justice* **2004**, *44*, 173–176. [CrossRef]
103. Werner, D.; Burnier, C.; Yu, Y.; Marolf, A.R.; Wang, Y.; Massonnet, G. Identification of some factors influencing soil transfer on shoes. *Sci. Justice* **2019**, *59*, 643–653. [CrossRef]
104. Galloway, A. Foreword. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1.
105. FBI Laboratory Division. Available online: https://www.fbi.gov/investigate/how-we-investigate/laboratory-division (accessed on 3 October 2023).
106. Police Czech Republic. Available online: https://www.policie.cz/default.aspx (accessed on 3 October 2023).
107. Antušková, V.; Šefců, R.; Šulcová, P.; Dohnalová, Ž.; Luxová, J.; Bajeux Kmoníčková, M.; Turková, I.; Kotrlý, M. Spectroscopic characterisation of Naples yellow variations in paintings from the turn of the 20th century. *J. Raman Spectrosc.* **2023**, *54*, 171. [CrossRef]
108. Pringle, J.K. Forensic geology: Getting geological principles and practices into the classroom. *Sch. Sci. Rev.* **2007**, *89*, 79.
109. Williams, T.J. Sherlock Holmes to CSI: Microscopy in the Forensic Geology Classroom. *Microsc. Microanal.* **2008**, *14* (Suppl. S2), 862–863. [CrossRef]
110. Spoto, S.E.; Boncaldo, A.; Capodivento, A.; Di Agosto, M.; Maccarone, D.; Scibilia, D. Aviation and Volcanic Ash Hazards: A Flipped Classroom Approach To Study Complex Systems. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2021**, *99* (Suppl. S1), 1–10. [CrossRef]
111. Spoto, S.E.; Somma, R.; Crea, F. Using a forensic-based learning approach to teach geochemistry. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2021**, *99* (Suppl. S1), 1–9. [CrossRef]
112. Somma, R. Advances in Flipped Classrooms for Teaching and Learning Forensic Geology. *Educ. Sci.* **2022**, *12*, 403. [CrossRef]
113. Somma, R.; Baldino, G.; Altadonna, A.; Asmundo, A.; Fodale, V.; Gualniera, P.; Mondello, C.; Pennisi, C.; Raffaele, M.; Salmeri, F.; et al. Education and training activities in forensic and biomedical sciences: The Laser scanner technology. *AAPP Atti Accad. Peloritana Pericolanti Cl. Sci. Fis. Mat. Nat.* **2023**, *101* (Suppl. S1), 1–18. [CrossRef]