

3° IBEROAMERICAN SEMINAR ON FORENSIC GEOSCIENCES

LA PLATA - ARGENTINA 2017
NOVEMBER 30th - DECEMBER 1st

CONICET CCT- LA PLATA, CALLE 8 # 1467 (e/62 y 63)



3rd Iberoamerican Seminar on Forensic Geosciences				
La Plata, Argentina				
November 30th 2017				
Topic	Country	Lecturer	Title	Hour
Opening of the Seminar	Argentina, Colombia, Brazil, Italy	Martín Vila Petroff, Francisco Pont Verges, Alan Temiño, Carlos Martín Molina, Fabio Salvador, Rosa María DiMaggio.	Conicet, Universidad Antonio Nariño, Policía Federal, International Union of Geological Sciences - Initiative on Forensic Geology (IUGS-IFG)	9:00-9:30
1. Soils (inorganic, organic, palynology, mycology)	Italy	Rosa María Di Maggio	Forensic soil: from the judicial site survey to the laboratory examinations	9:30-10:30
	Scotland	Lorna Dawson	Forensic soil trace evidence: collection, recovery and examination, examples from case work	
	Coffee-Break			10:30-11:00
	Argentina	Cecilia Tranchida	Fungi: forensic evidence?	11:00-12:00
	Argentina	Leticia Povilauskas	Forensic palynology: a science that advances in criminal investigation	
2. Antropic particles	Estados Unidos	William Schneck	Antropic particules	12:00-13:00
Free Lunch				
3. Minerals and gem fraud.	Brazil	Erich Adam Moreira Lima	Transnational traffic of gemstones: the Brazilian Federal Police's investigation on the Turmalina Paraíba case	14:30-15:30
	Brazil	Nelson Fava	A small contribution on the mineral chemistry of tourmalines seized during the "Operação Sete Chaves" (Seven Keys operation), Brazilian Federal Police, Brazil.	
4. GIS in forensic geology	Coffee-Break			15:30-16:00
	Ireland	Jennifer McKinley.	An introduction to GIS in forensic geoscience'	16:00-18:00
	Mexico	José L. Silván	Remote sensing of clandestine graves – a review	
	Ireland	Jennifer McKinley.	Developments in GIS and forensic geoscience with case studies'.	
	Mexico	José L. Silván-León F. Dozal	Evolutionary approach for detection of buried remains in hyperspectral images	
December 1st 2017				
5. Geophysics (searching missing people). Searching other evidence (drugs, weapons, tunnels, waste)	Argentina	Guillermo Sagripanti	Forensic geology in Argentina applied to the search of victims of forced disappearance	9:00-10:30
	Mexico	Diego Quiróz Suárez	Preliminary results of geophysical and remote sensing techniques as an aid to forensic archeology research in Mexico.	
	Colombia	Carlos Martín Molina	Geophysics, environmental variables and challenges to the search of missing people	
	Coffee-Break			10:30-11:00
	Brazil.	Marcelo Blum	Search for drugs, weapons, tunnels, soil contamination: how geophysics has Helped the Brazilian Federal Police	11:00-12:00
Free Lunch				
6. Identification of people and postmortem time (taphonomy, anthropology, genetics, entomology).	Argentina	María Gutierrez	Current taphonomy and forensic sciences: Challenges and interactions for disciplinary construction	13:30-15:30
	Australia	Shari Forbes.	Identification of people and postmortem time, particularly relating to taphonomy and our taphonomic (i.e. human decomposition) facility in Australia which has helped police investigations	
	Argentina	Nestor Centeno	Forensic entomology: generalities and case studies	
	Brazil	Maia Ozana	Survey of entomological traces relating to forensic sciences	
	Coffee-Break			15:30-16:00
	Argentina	Rocio García	Contribution of forensic anthropology to administration of justice	16:00-17:00
	Argentina	Luciano Valenzuela	Spatial distribution of stable isotopes as a tool in forensic investigations	
Argentina	María Mercedes Lojo	Individual identification by means of DNA profiles comparision. a Bayesian approach		
7. Geologist in the court and forensic context in Argentina	Scotland	Lorna Dawson	Report writing and court presentation	17:30-18:00
Closing	Scotland, Colombia	Words	Lorna Dawson, Carlos Martín Molina	18:00-18:15

3rd Iberoamerican Seminar on Forensic Geosciences November 30th and December 1st 2017

Organization of the Proceedings Book:

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3rd Ibero-American Seminar on Forensic Geoscience
La Plata, Argentina
30th November 2017 to 1st December 2017

Welcome & Introduction

On behalf of the International Union of Geological Sciences (IUGS), Initiative on Forensic Geology (IFG), welcome to the 3rd Ibero-American Seminar on Forensic Geoscience, in La Plata, Argentina. This aim of this event is to focus on recent global advancements in forensic geology with emphasis on Latin America. This represents the third in a series of seminars on the same theme. The first was held in Bogota, Colombia, in 2009. This was organized in collaboration with the Geological Society of London Forensic Geoscience Group, the National University of Colombia, Colombian Federal Police and National Institute of Legal Medicine and Forensic Science. A technical meeting on forensic geology subsequently took place in 2010, Montevideo, Uruguay as part of the IUGS Working Group on Forensic Geology (the predecessor to IUGS-IFG), and here the 2nd Ibero-American Seminar on Forensic Geoscience was considered. This then took place in Brasilia, Brazil, in 2013, in collaboration with the Brazilian Federal Police. Additional forensic geology training and knowledge transfer events took place in Brazil in 2015, 2016 and 2017. Forensic geology events were also held in Mexico in 2010 with the Procuraduría General de Justicia del Estado. Furthermore, in 2016, a meeting was held in the United Kingdom that included delegates from Chile, which concentrated on search methods to help locate, recover and identify those who disappeared during Pinochets Dictatorship (1973-1990).

Unfortunately, throughout Latin America (and like many other parts of the world) serious crimes prevail, and are likely to continue in the future. These include crimes of a criminal, humanitarian and environmental nature. As noted above this involves; the search for missing persons and unknown graves associated with organized crime, mass burials, torture and homicide; environmental crimes such as deforestation and pollution; drug trafficking; violation of human right; terrorism; smuggling; fraud; embezzlement; robbery; sexual crimes; precious mineral, fossil and metal theft and fakes. Forensic geology may potentially assist with the investigation of these types crimes. The development and applications of forensic geology throughout Latin America appears to have increased in recent years. There is a growing awareness of the benefits a geologists/geoscientists may bring to some investigations. This has been facilitated by IUGS-IFG and the series of events organized and hosted with the, Ibero-American Seminar on Forensic Geoscience. Experiences have shown that

a forensic geologist/geoscientist can most effectively contribute a police or law enforcement case when working as a fully integrated member of an operational and multi-disciplinary team, and alongside other experts.

The 3rd Ibero American Seminar on Forensic Geoscience has brought together over 200 delegates, from at least 10 countries, including; forensic geologists, forensic geoscientists, police, academics and students. The papers presented primarily focus on forensic geology although related disciplines include forensic palynology; gemstone chemistry for international trafficking; forensic trace evidence and mineralogy; GIS and remote sensing; forensic archaeology; geophysics; environmental geoscience; taphonomy and forensic science; forensic entomology; stable isotopes as a tool in forensic investigations; forensic genetics; report writing and presentation in a court of law.

This event has taken a number of years to plan and implement. It would not have been possible without the funding and support provided by IUGS, and the commitment and dedication of the IUGS-IFG Committee Members, in particular Carlos Martin Molina Gallego and Fabio Salvador. The IUGS-IFG who attended and presented are also acknowledged for the contributions; Lorna Dawson, Shari Forbes, Bill Schneck, Rosa Maria Di Maggio, Jennifer McKinley and Alastair Ruffell. The support and collaboration provided by Conicet from Argentina, Universidad Antonio Nariño in Bogotá Colombia and Polícia Federal from Brazil, is also valued and gratefully acknowledged. It is anticipated, the 4th Ibero-American Seminar on Forensic Geoscience to take place in Mexico in 2019.



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Soils (inorganic, organic, palynology, mycology)

Forensic soil: from the judicial site survey to the laboratory examinations

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Regardless of what type of crimes and their narratives the forensic geologists are involved with, they need to carry out a fundamental approach: to study, to recognise, to analyse, and to interpret the geographical, physical and geological features of the environment where the crime had been place. Forensic geologists have to be able to search and to collect suitable information from the environment in order to put them in the specific criminal context and in its dynamic. By all means, the judicial site survey and the soil gathering are ones of the most sensitive activities that forensic geologists carry out during the inquiries. During these stages, the probative validity of soil evidence could depend on: (i) the way the sample was gathered; (ii) all those activity carried out from the seizure and preservation of items, to the collection of soil from them; (iii) undervaluation of the potentiality of soil analyses during the firsts stage of investigation and no knowledge of the requirements of their application. For these reasons, the optimal judicial soil survey and gathering of soil samples are possible when those who perform the collection of evidence are highly specialized in forensic geology techniques, and are perfectly informed of the crime, so that they are aware of what, where and how to collect soil evidence. Successively, the soil analysis are performed in forensic laboratories. Although a standard reference, universally accepted, procedure is not yet established, forensic laboratories specialized in soil analysis implement their procedures based on a logical analytical sequence and the optimization of techniques to get results that are unique as possible and representative of the specific characteristics of the examined samples. In general, all procedures include preliminary analytical techniques that provide general guidance on the characteristics of the soil sample, and detailed analytical phases (the choice of which varies according to the particular characteristics of the particles of the substances and materials in the soil and the information that can be obtained) that can give more detailed information on the individual particles that compose it. The optimum progression of the analytical techniques depends on a number of factors

such as the amount of available sample and the results obtained in the earliest analytical steps. In this context, the results of the preliminary examinations suggest the most appropriate analysis to be performed in the subsequent procedural steps.

Forensic Soil trace evidence: collection, recovery and examination, examples from case work

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Forensic geo science is an increasingly important discipline involving soils, minerals, dusts, plants and rock fragments to determine provenance i.e. to provide a chronology of their ownership, custody or location and as a comparison with a crime scene. Soil materials have been used as forensic trace evidence from early Roman times, and are often highly distinctive from one region to another [1]. Such traces are extremely useful in a forensic context, because of their environmental specificity; their high levels of transferability; their ability to persist on items such as clothing, footwear, tools and vehicles; and their high levels of preservation after long periods of time. This resilience makes soil trace materials, often present at crime scenes and forensic exhibits, highly valuable forms of intelligence and evidence that can aid crime investigations and scenario reconstructions. Significant advances in forensic geoscience over the past decade, in the development of analytical approaches, miniaturisation and also in understanding the behaviour, transfer, persistence and preservation of sediments, soils and plant material have widened their applicability and evidential value. Evidence samples can be analysed using a wide range of complementary methods that address their physical, chemical and biological components with greater precision, speed and accuracy than ever before. This now permits samples of less than 10 milligrams to be accurately characterised, and permits forensic soil science to also contribute to cold case investigations, both in providing intelligence and evidence in court. Examples will be presented of case work where soil has played a pivotal role.

Sediments/soil on footwear and vehicles can indicate where a crime may have taken place, and may provide evidence of a person being at a particular place of interest. Improved analytical capabilities, coupled with the development and availability of relevant databases, allow forensic geoscientists to help police to search for unknown objects or people, prioritise areas for investigation or search, and provide robust and reliable evidence in court. Forensic geoscience has mainly been used in the past in the context of high-impact crimes such as murder, rape, aggravated burglary and terrorism investigations, where resources allow it. However, techniques are becoming cheaper and faster, and have the potential to become regularly used. With developments in analytical technology, and an increasing understanding of how soils and sediments are distributed within natural and anthropogenic environments, forensic soil science has more power to answer questions such as: 'Where did the soil material come from?', or 'Where has this item been?'. Understanding the context

of a specific case is crucial to help answer such questions. In addition, being able to explain the significance of the evidence that has been analysed, and demonstrating logically and transparently how a conclusion has been reached, remains important for forensic soil science specifically and trace evidence generally. This talk will cover the principles of forensic geoscience trace evidence from the point of collection samples at a crime scene, recovery of soil material from questioned items, to the analysis of that trace evidence. Examples of where soil has been used in both search and as evidence will be presented.

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Fungi: forensic evidence?

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Forensic mycology is a relatively new term used for a description of the fungal species present in the vicinity of human cadavers as well as those fungal groups potentially useful in establishing a time of death. Taphonomy is the subdiscipline of paleontology that studies the organic and fossilized postmortem remains in the records from different geologic periods. Forensic taphonomy aims at understanding the conditions influencing the decomposition process to estimate the postmortem interval and determine the cause and manner of death. In recent decades, only few case studies involving both mycology and taphonomy based on fungi have been used as a basis for forensic mycology in the United States, Japan, and Brazil as well as more recently in Argentina. This new subdiscipline of the forensic sciences is increasing worldwide as certain groups of fungi have generated a substantial body of data concerning the decomposition of cadavers and their related environment. This information has demonstrated that different fungal groups?referred to as ammonia or postputrefaction fungi?can serve as aboveground indicators of the presence of graves in forest ecosystems. The burial of human cadavers under natural or seminatural conditions is sometimes performed in an attempt to hide the evidence of a crime. The ability to locate clandestine graves by means of fungi can thus constitute a useful tool in the investigative process. By another hand, the presence of fungi on the surface of corpses has been recognized for some time by forensic pathologists, that association has still not received much attention by researchers since studies of the fungal biota present on decomposing bodies along with the relevant literature have been extremely scarce in the past. Only quite recently forensic scientists have begun to consider the distinct possibility that fungi can be used as tool in legal medicine since the different groups of fungi present on a cadaver can be useful in estimating the time of death. Studies on the relevant role of fungi in postmortem decomposition have been increasing of late, as evidenced by a rising number of experimental descriptions and case studies in forensic mycology since the corpse is a

plentiful source of organic material. Moreover, in view of the variation of species that could be in contact with corpses under different growth conditions, the isolation of certain fungal species in specific geographical areas as an aid in the characterization and classification of the typical regional microorganisms could provide information on the location of a death.

Palinología Forense: una ciencia que avanza en la investigación criminal. Forensic Palynology: a science that go forward in the criminal investigation

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The Palynology is a discipline within Botany dedicated to the study of pollen grains and spores. This discipline can be applied in different fields, as well as the oil and hydrocarbons, ecology, taxonomy and systematics of plants, and the legal and forensic area, among others. In the forensic area, the Palynology serves to provide useful information on the circumstances in which a crime, a murder occurred. The objective of this contribution is to publicize the activities developed on the basis of Forensic Palynology in the criminal investigation; and make available some suitable natural scientists to encourage their participation in order to add contributions to clarify when a crime expert from Palynology methodologies. In some countries, in recent years we has been concerned to extend support tools and study for judges, prosecutors and authorities, putting at their disposal element analysis study as forensic palynology. A collection and transportation of unsuitable samples and / or accidental contamination of forensic samples will produce inaccurate results. In the laboratory, under the light microscope, a total of 300-400 palinomorfs per sample were counted, the percentage counts were overturned tables and graphical charts. The types and amounts of pollen grains per sample were compared between different samples collected from the crime scene and surroundings. At this stage, prevailing statistical analyzes were performed to evaluate the data obtained from sampling and knowledge of where the murder occurred, which is very useful in the investigation of a crime such as the one presented in this paper, and today is in vogue.

Antropic particles

Anthropogenic Material in Soil. Trace types, lab collection methods and case studies

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Anthropogenic (man-made) materials found in soil can be exploited in both geosourcing and comparative forensic analysis of soil. Particularly in the urban environment, the detritus of human materials incorporated into soil can have great probative value in any investigation. A description of commonly encountered man-made traces such as building materials, metals/alloys, polymers, fibres, fly ash and wear products with accompanied case studies will be presented. A variety of laboratory micro-collection and isolation methodologies to include particle picking, sieving, floatation, magnetic separation, filtering, tapping and aqueous density and harmonic frequency separation will be studied.

One of the cases to be presented is as follows: A body was found lodged in the back seat of a minivan parked along a street. Soil was observed clinging to the wheel wheels of the vehicle. Examination of this soil and comparison soil from the driveway of a run-down dwelling in a distant location revealed similar minerals and botanicals. Mixed in the soils from both the vehicle and the driveway, were a variety of red, green, white and gray particles, some with adhering asphalt and fiberglass. The apartment adjacent to the driveway lacked rain gutters. Over time, decaying asphalt roofing granules fell from the roof and mixed with the soil. This unusual association of building materials in soil proved useful to the prosecution of the homicide.

Minerals and gem fraud

Transnational traffic of gemstones: the Brazilian Federal Polices investigation on the Turmalina Paraíba case

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On May 27, 2015, the Brazilian Federal Police and the Public Federal Ministry launched Operation Seven Keys with the objective of combating and dismantling a criminal organization that acted in the illegal extraction and commercialization of the Paraíba tourmaline. The Task Force have charged eight people (Case No. 000013534.2015.4.05.8205), including two mine owners, a state congressman and an Afghan gemstone trader. The unlawful organization, have used an intricate network of offshore companies in order to negotiate the sale of Paraíba tourmaline as well as to launder money. The Federal Prosecutors also requested that a minimum amount of R 60.000.000,00 (USD 18.500.000,00) be set aside to repair damages caused by the criminal organization. The defendants are accused of usurpation, mining without environmental license, racketeering, money laundering, tax fraud and criminal organization using firearms and international tentacles. Parazul and Paraíba Tourmaline Companies had licenses to conduct scientific research but not to extract gemstones for commercial use. But one of Parazul's Company partners said in a sworn statement that is part of a plea bargain agreement seen that the mine was producing the gemstones. The criminal scheme began with the extraction of the Paraíba Tourmaline in the district of So Jos da Batalha, Paraíba State. Parazul company illegally extracted gemstones and sent to a mine in Parelhas, Rio Grande do Norte State, where obtained legal certificates. From Rio Grande do Norte State, the product was shipped to Governador Valadares (Minas Gerais State), to be cutted. FBI, in cooperation with this investigation, photographed the performance of this criminal organization in the show that took place in the city of Tucson, Arizona (February 2014). Merchants sent the gems abroad, in external markets (Bangkok, Hong Kong, Tucson, Houston and Las Vegas).

**A small contribution on the mineral chemistry of
tourmalines seized during the Operao Sete Chaves, Seven
Keys operation,**

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Tourmalines are investigated using the comparison between ordinary optical and physical proprieties of some samples and respective EPMA, FRX, and Raman data. Sm/Nd isotope data obtained from the both host rocks of S. J. da Batalha/PB and Parelhas/RN tourmaline mines are shown to help the debate about the gemological material seized during the operation.

GIS in forensic geology

An introduction to GIS in forensic geoscience

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Spatial technologies and the use Geographical Information Science (GIS) are increasing being used in forensic search investigations. The powerful capability of GIS to store, manage and analyse spatial data layers means different georeferenced spatial data can be integrated and queried in a forensic geoscience investigation. This presentation introduces how to set up and manage a GIS based framework for forensics. A GIS-based landscape approach is explored for collecting, integrating and analysing different types of georeferenced data that are routinely used in forensic investigations. Starting with a digital desk-based study, which enables integration of information from historical and contemporary aerial imagery with geological and soil information, a workflow for GIS in forensic geoscience is presented. As part of the workflow, the development of topographic models and more complex spatial data analysis provides baseline knowledge for reconnaissance walk-over surveys. The combination of a digital desk-based study with field reconnaissance generating georeferenced forensic data can assist in the creation of GIS-based digital red-amber-green (RAG) maps to prioritise potential search areas with the ultimate goal of a higher degree of success in search operations.

Remote sensing of clandestine graves

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In this presentation I will summarize the recent efforts from both remote sensing specialists and forensic sciences researchers for developing new technologies that can be used for searching clandestine graves over large areas. Remote sensing (RS) is a relatively new field of scientific and technological development that allows detecting objects of interest at a distance. The main advantage of these techniques is the substantial increase in the search area when compared with ground surveys,

which require an extensive deployment of people in the field. Hence, RS techniques can reduce costs and risks associated with field deployments. In addition, information derived from RS is easily incorporated into a geographic information system, thus allowing more comprehensive analyzes of data [1]. Geophysics and forensic anthropology researchers have tested technologies that employ versions of terrestrial instruments on aboard of aerial platforms, including thermal imaging, magnetic or electromagnetic profilers, and ground-penetrating radars [2, 3]. These sensors present variable results, and are sometimes limited by numerous sources of "noise" that lead to false detections or omissions [4]. On the other hand, remote sensing specialists have used aerial photographs to detect abnormal changes of vegetation and landmarks on the graves [5]. Ultraviolet photographs have also been used to map the maturity of vegetation, since graves present younger vegetation than other areas due to a change in soil pH [6]. Obviously the detection of clandestine graves through aerial photographs presents limitations in terms of spectral sensitivity since they detect the reflected light signal in three spectral bands, generally within the visible spectrum. More recent investigations have evaluated the effectiveness of multispectral and hyper-spectral images in the detection of human remains [7, 8, 9]. For instance, [8] used in situ data acquired with the hand held spectrometer ASD FieldSpec FR (in the spectral range of 350 – 2500 nm) and the HyMap II sensor (125 spectral bands in the range of 450 – 2500 nm at 4.7 – 5.2 m spatial resolution) for detecting simulated animal mass graves. They found that, on both scales (in situ and air-borne), the graves with bodies did have a signature that distinguishes it from graves that did not contain bodies. They also observed that regeneration of vegetation was strongly inhibited by the presence of residues. A more recent study [9] had demonstrated the feasibility of hyperspectral sensors (CASI and SASI covering the spectral ranges of 408 – 905 nm and 883 – 2524 nm respectively) for the detection of single graves, but also acknowledged that additional research was needed to consider other environments and areas with different types of vegetation. Along this line, the time for image acquisition and sensed spectral range has proved to be critical for a successful detection [10].

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Developments in GIS and forensic geoscience with case studies

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Over the last number of years, the use of Geographical Information Science (GIS) for forensic search strategies has been developed as part of training workshops supported by the International Union of Geological Sciences (IUGS) Initiative on Forensic Geology (IFG). The first was held in Brisbane, Australia (2012) in collaboration with the Australia Federal Police, followed by the Second Iberoamerican Workshop in Brazil (2013), with more recent events in Sicily (2015) and Dublin (2016). The GIS-based methodology has a very practical application for police, crime scene investigators and forensic geoscientists. Developments in GIS go far beyond mapping to offer a set of decision support tools incorporating the spatial analytical capabilities of GIS and ultimately enabling better management and understanding of the interrelated nature of geoforensic evidence involved in ground searches (McKinley 2017). The progress of developments in GIS and Forensic Geoscience is presented with a number of case studies used to exemplify the innovation. Looking to the future, the use of GIS capability is explored as a real-time GIS-based Decision-making Tool to provide more effective and efficient crime scene management and as a result increased success rate for search activities.

McKinley, J 2017, 'The application of geographic information system (GIS) in forensics geoscience' *Episodes*, vol 40, no. 2, pp. 166 – 171.

Devolutionary approach for detection of buried remains in hyperspectral images

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The localization of clandestine graves is a difficult, prolonged and complicated problem, which may endanger the personnel investigating and conducting the search. Recently, the hyperspectral imaging analysis has been successfully utilized to locate clandestine graves. Moreover, it can be used to search in larger areas without placing the personnel at risk. This study presents an evolutionary method based on Genetic Programming, called Brain Programming (BP), for the selection and extraction of spectral and spatial information from hyperspectral data, aiming to clandestine graves detection. Brain Programming is utilized for automating the design of, what we called, hyperspectral visual attention models (H-VAM). An H-VAM is an algorithm whose objective is to establish a relationship between the spectral and spatial properties of the scene for highlighting the regions in the image that represent graves. Four graves with varying number of carcasses of pigs and three false graves were simulated. Afterwards, during a period of six months, in situ spectral measurements of ground were taken. Two experiments were implemented relying on ground-truth data and the resulting twelve hyperspectral images. For both of them, the BP selects spectral bands and, through the H-VAM, extracts spectral and spatial features from them. At the same time, BP finds the arithmetic combination of those features that best allows to, the H-VAM, classify graves and no-graves. The difference between the two experiments is the classification accuracy assessment that guides the BP search of the best H-VAM, this is the one with highest classification accuracy. Experimental results demonstrate that the proposed BP method improves the graves classification accuracy compared with previous PLS-VIP approach that only utilizes spectral information. In addition, the analysis of the best solutions yielded information consistent with previous researches. Results suggest that the best time for image acquisition is after three months of the burial, although our approach detects some of the graves in the images acquired in the first three months. Besides, in the analysis of the best solutions, obtained in both experiments, there is a clear tendency to use spectral bands that respond to the vegetation and the water content of the plants. Finally, results also demonstrate that the number of buried bodies plays an important role for detection. Such data could be very valuable in the area of forensic science, as well.

Geophysics (searching missing people). Searching other evidence (drugs, weapons, tunnels, waste)

Forensic geology in Argentina applied to search of victims of forced disappearance

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Between 1976 and 1983 the Argentine Republic was under a de facto government called "civic-military dictatorship". During this period thousands of people were abducted and made to disappear as part of a plan to restrain and subdue the actions of groups considered subversive. To this end, about 340 Clandestine Detention Centers were installed in the country, where the methodical use of torture, murder, and disappearance was common (Sbato, 2006). Clandestine burials took various forms depending on the methods of body disposal in mass and individual graves as well as the techniques for covering them up (Sagripanti et al., 2013). It is estimated that between 9,000 and 30,000 people were victims of enforced disappearance perpetrated by the above-mentioned regime. Despite the beginning of an uninterrupted period of successive democratic governments in 1983 forcible disappearances also took place. Around 210 such cases were reported by the Coordinator against Police and Institutional Repression of Argentina for the period 1983 – 2014. The Forensic Geology Team of the National University of Río Cuarto, Argentina, was created in 2004. It cooperates with the Judiciary Power, Human Rights Organizations, the Argentine Forensic Anthropology Team, and relatives of the disappeared, to locate sites of clandestine burials of victims not only of enforced disappearance during the last civic-military dictatorship but also involuntary disappearance in democracy; for this purpose, it develops a methodology that consists of several research stages (Sagripanti et al., 2013). Non-invasive, non-destructive techniques of geophysical prospecting, such as GPR technology, are used. Due to the different techniques used for concealment of the graves, such as buildings or other structures, concrete or paved surfaces, among others, the GPR has been used for the detection of shallow anomalies as a search objective. The results obtained in the surveys carried

out by the Forensic Geology Team in different analogous and real test situations of clandestine burials and their concealment allow to consider that the use of GPR in the detection of anomalies in the subsoil together with the application of other geological-geophysical techniques significantly increases the possibility of findings.

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Preliminary results of geophysical and remote sensing techniques as auxiliar on forensic archeology research in Mexico

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We present preliminary results obtained from a test field of simulated burials with different characteristics, in which remote sensing and geophysical surveys are being carried out systematically and periodically during a year approximately. Among the geophysical methods, there are electromagnetic methods (ground-penetrating radar and conductivimeter) and electrical resistivity (capacitive and galvanic). We present observations obtained from the geophysical surveys conducted before and after the simulations. These observations will be compared to analyze the structure of post-burial anomalies in the study site. The aim is to evaluate the use of different geophysical methods in forensic archeology in order to contribute to the development of a practical methodology for optimizing the information acquisition process about the geometry and physical properties of buried organic and inorganic structures. Regarding the remote sensing approach the objective is to understand the effects of buried organic and nonorganic matter on the optical reflectance for a wide range of optical wavelengths. For this matter we use a full-range (350-2500nm) field spectroradiometer with a field of view of 25 degrees and a spectral resolution of 1nm. In a previous experiment we determined that the most important spectral wavelengths for detecting buried remains fall within the SWIR spectral region (1000-1800nm), a region that is just recently being acquired by commercial satellites such as WorldView3 at a relative coarse spatial resolution (7.5m pixel size). Hence,

the question is whether such imagery can be used for detecting clandestine graves in a region-wide search. Therefore, the data being collected at the study site will help to evaluate both the effect of sensor's spatial resolution as well as the effect from the presence of inorganic objects on the effectiveness of grave detection through an optical remote sensing system.

Geophysics, environmental variables and challenges to the search of missing people

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In Colombia, there are currently around 84,000 missing people according to government data of which an estimated 24,000 are due to forced disappearance. The search for burial sites of common and individual mass graves are usually done using metal probes, boreholes, and trenches in the places where the informants indicate that the deceased may be, for which judicial investigations are often unsuccessful and the uncertainty of knowing whether the search motive remains really were or were not in the examined site. Due to the above, an experimental investigation was carried out in two forensic laboratories with 12 simulated mass graves, located in different geological and environmental conditions, in which geophysical geoelectric methods were applied, in order to generate new knowledge in the intertropical zone, which allows to evaluate their support in the search for missing persons. The best projection was the resistivity followed by the georadar. Based on these results, the implementation of geophysical methods began in Colombia, it was in a place of difficult access and abundant vegetation, data were taken with an electric tomograph for searching a person who was disappeared and then murdered in 2003; according to the versions the mass grave can have a size close to 40 cm x 40 cm. The place has a lot of vegetation, humidity and warm weather, the soil has organic matter and clay. Then, in desktop work the information was processed with the Earthimage software and several tomographies were obtained, two of the cells with negative anomalies in 2 points that could be related to the place of interest. A drone was also used to make the DTM. A second stage will be carried out in which the analyzed in the desk will be confronted with the new field work. In the search for missing people it is also important to approach scenarios where many people are buried by large thicknesses of mud and rocks, which is why it is a great challenge to find them and hence the importance of starting the approach from the geosciences, since these situations are not found in protocols and you do not have the necessary experience to deal with them.

Search for drugs, weapons, tunnels, soil contamination: how geophysics has helped the Brazilian Federal Police

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Sometimes, the criminal expert faces with a problem involving the location of underground materials. Many methods may provide the expert with immediate answers or may require analysis that is more detailed. Many of these methods are disturbing and therefore destructive. Using as a tool the variation of the physical and chemical properties of the materials, the geophysics, increasingly used by the police throughout the world, appears as a non-destructive response and of very low risk both in the preservation of the evidence at the crime scene and in the security of the professional himself. Geophysics is the application of principles, methods and procedures of physics in the study of the Earth, having as its interest its solid, liquid and gaseous parts, measuring its physical fields and the contrasts of the physical and chemical properties of the geological materials. To access these properties, several geophysical methods are used: (1) Some methods use the response of various parts of the electromagnetic spectrum, including gamma rays, visible light, radar, microwave and radio waves; (2) Others use the acoustic and / or seismic behavior of the medium; (3) And others use potential fields such as gravity and the earth's magnetic field. When we refer to geophysical research techniques, there are three categories: (1) airborne; (2); and (3) wells. Each of these three categories comprises a variety of methods, which in turn have a significant number of variants. As the vast majority of the methods applicable to expert examinations are surface, the focus is on the succinct description of some of them. The most widely used, the Ground Penetrating Radar (GPR) is a method that uses radio waves (electromagnetic) at high frequencies ranging from 10 MHz to 3 GHz and excels in shallow investigations due to its high resolution and acquisition of a large volume of data taken in a short time interval (ANNAN, 2002). GPR has several applications mainly to locate structures and features in small depths (from centimeters to a few tens of meters). Because it is a non-destructive method, it is an often locator of artifacts buried by man, such as archaeological objects, excavations, pipes and even corpses. The physical principle and methodology of data acquisition of this radar are similar to the techniques of reflection of elastic waves (sonorous) like seismic, sonar and echography. This method consists of the transmission of repeatedly radiated electromagnetic waves (EM) into the subsoil by transmitting part of a bipolar antenna positioned on the surface. The signal propagates through the medium and it depends on its electromagnetic properties, such as electrical conductivity, dielectric permittivity and magnetic permeability. The propagation of the EM signal is subject to the frequency of the transmitted signal and the electrical properties of the materials therein. These electrical properties are mainly related to the amount of water in the medium. Any change in these properties causes some of that transmitted signal would be reflected or diffracted. Thus, reflected and / or diffracted radar waves are received through the other portion of the antenna, called the receiver, which digitizes and sends the

signals to a pre-processing unit, commonly composed of a portable microcomputer, to be recorded time that is the double time, the transmitted signal to the returned signal (REYNOLDS, 1997). Electromagnetic methods have been developed since the early 20th century. These methods can provide rapid measurements of soil electrical conductivity (FROHLICH, LANCASTER, 1986). One of them functions as a time domain metal detector that detects both ferrous and non-ferrous metals. These instruments, with interleaving of 1 – 4m, can produce a resolution of sufficient amplitude to detect the contrast of the soil that fills an excavation, for example. The method works with a powerful transmitter (transmitter coil) that generates a preliminary magnetic field introduced into the ground. This field induces a swirl of currents in nearby objects whose degradation produces a secondary magnetic field measured by a receiving coil. The induced current in the soil dissipates entirely with the passage of time and only the current in the material will still be producing a secondary field. What we assimilated in all this forensic experience was that in the practice of geophysics, in the case of hidden objects are interruptions of continuous reflectors that indicate the existence of changes in the structure of the soil. In general, these changes, commonly resulting from excavations, are the geophysical method contribution. In the case of highways, on the contrary, the continuity indicates its good state and the interruptions are its dubious quality. The geophysics applied to forensic science has led to the development of more functional and even less expensive equipment, such as GPR and conductivity meters, thus contributing to a more efficient police action.

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Identification of people and postmortem time (taphonomy, anthropology, genetics, entomology)

Actualistic taphonomy and forensic sciences: challenges and interactions for disciplinary construction

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We present preliminary results obtained from a test field of simulated burials with different characteristics, in which remote sensing and geophysical surveys are being carried out systematically and periodically during a year approximately. Among the geophysical methods, there are electromagnetic methods (ground-penetrating radar and conductivitymeter) and electrical resistivity (capacitive and galvanic). We present observations obtained from the geophysical surveys conducted before and after the simulations. These observations will be compared to analyze the structure of post-burial anomalies in the study site. The aim is to evaluate the use of different geophysical methods in forensic archeology in order to contribute to the development of a practical methodology for optimizing the information acquisition process about the geometry and physical properties of buried organic and inorganic structures. Regarding the remote sensing approach the objective is to understand the effects of buried organic and nonorganic matter on the optical reflectance for a wide range of optical wavelengths. For this matter we use a full-range (350 – 2500nm) field spectroradiometer with a field of view of 25 degrees and a spectral resolution of 1nm. In a previous experiment we determined that the most important spectral wavelengths for detecting buried remains fall within the SWIR spectral region (1000 – 1800nm), a region that is just recently being acquired by commercial satellites such as WorldView3 at a relative coarse spatial resolution (7.5m pixel size). Hence, the question is whether such imagery can be used for detecting clandestine graves in a region-wide search. Therefore, the data being collected at the study

site will help to evaluate both the effect of sensors spatial resolution as well as the effect from the presence of inorganic objects on the effectiveness of grave detection through an optical remote sensing system.

The Australian facility for taphonomic experimental research

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This presentation will discuss the development of the Australian Facility for Taphonomic Experimental Research (AFTER), colloquially referred to as a 'body farm'. Taphonomy involves the study of human and animal remains from the time of death to the time of discovery. The aim of research in the field of forensic taphonomy is to better understand the physical, chemical, and biological processes of soft and hard tissue decomposition. The process of decomposition is inherently impacted by the surrounding environment, including climatic conditions, geological formation and the ecological community. Until recently, the only facilities that conducted human decomposition research were based in the USA however their data could not be extrapolated to Australia due to its distinctly different environment.

AFTER opened in 2016 as a national research and training centre that will revolutionize the way in which criminal and death investigations are conducted in Australia. It involves collaboration between universities, police agencies, and forensic science services. A greater understanding of the decomposition process can assist police and forensic investigators to search for, locate, recover, and identify victim remains. Such research is particularly important for investigations involving missing persons, and/or victims of homicide, genocide, or mass disaster.

The presentation will provide an overview of the need for these facilities in Australia and elsewhere in the world, the process involved in establishing the first facility in Australia, as well as examples of how the research benefits the scientific and law enforcement community. A recent case example will also be discussed.

Forensic entomology: Overviews and cases reports

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Forensic Entomology is the study of carrion fauna that develops in a body from the moment of death when the decomposition process of tissues begins along with a heterotrophic succession of several assemblages of arthropods, mainly insects, that ends with the disintegration of the body. The carrion is a temporary microhabitat and a food and reproductive resource for insects and their immature stages. The

main contribution of cadaveric fauna is to know the Postmortem Interval (PMI) and the conditions of the environment in which the death occurred. The state of development of the organisms that breed in the remains allows to estimate the time elapsed since the first colonization of the body, that is since it was exposed for the first time to the action of the insects, contributing in this way to the estimation of the postmortem interval. In Argentina, field researchs have been carried out to know the cadaveric fauna using as models dead pigs (*Sus scrofa*) exposed to insects in different conditions and sampled at regular intervals during the decomposition process. This has made it possible to know the regional carrion community and its seasonal patterns. This information has been very useful for forensic investigation. Two case studies showing the methodology of work and its results will be exposed.

Survey of entomological traces relating to forensic sciences

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Forensic entomology is the scientific field in which the insects become indispensable traces to the criminal investigation. Evidence of insects may be used to show when a body has been moved to a second location after death, or if a body was sometime attacked by animals or by the killer who returned to the crime's scene, use of narcotics, damage to real estate properties, contamination of materials, narcotics and stocked products among other cases presented to forensic investigation (Santana and Vilas Boas, 2012). In this context, surveys of entomological traces have been carried out to supply a database on Forensic Entomology, an extremely useful tool that will help researchers and contribute to a better routine of the experts. This database should contain information about the insects of forensic interest, including geographical distribution and relevant bibliography. The Brazilian Forensic Project (PRO-FORENSICS) has been carried out since January/2015 and have as main objectives the development of an insect's traces database and, searching for solutions to public safety, establishment of a partnership between the Brazilian institutions Federal Police (PF), Federal University of Technology ? Paran (UTFPR), Federal University of Paran (UFPR) and the University of So Paulo (USP). The PRO-FORENSICS team is composed by: Prof. Dr. Paulo Jos Abatti (coordinator at UTFPR), Prof. Dr. Rubens Alexandre de Faria (database system and pattern recognition/UTFPR), Prof. Dr. Ozana M. A. Maia (Entomological traces/UTFPR), Dr. Fabio A. S. Salvador (practice demand/PF), Prof. Dr. Vander F. Melo (Mineralogy and soil traces/UFPR), Prof. Dr. Paulo Oliveira (palynological traces/USP). Some actions have been taken at the UTFPR, among then, it was created a Forensic Sciences Research Group at the Biomedical Engineering Graduate Program (PPGEB/UTFPR). The UTFPR Forensic group is composed by Biomedical Engineering researchers, master and doctor degree students, undergraduate students belonging to the Tutorial Education Program (PET) and the Scientific Initiation Program (IC). The group has the collaboration of forensic researchers from the Syracuse University

? USA. The first surveys of entomological traces have been done using *Cannabis sativa* samples at the PF facilities in Curitiba (Paraná, Brazil) and traces of the following insect's species have been found: *Euschistus hero* (Hemiptera; Pentatomidae), *Camponotus blandus* (Hymenoptera; Formicidae) and one belonging to the Coleoptera (Buprestidae) order. Pictures have been taken from the insect's traces and a pattern recognition algorithm have been developed in order to build the Entomological database. The initial results have shown that the database will serve as a geographical search tool applied to Criminology in Brazil.

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Contribution of forensic anthropology to the administration of justice

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Argentinean forensic anthropology is worldwide known because of its participation in the investigation of the cases of disappeared people under the last military government. But the challenge that forensic anthropology is facing today, is to integrate in the forensic investigation team of specialist from many different scientific fields as well as legal and law enforcement specialists in order to solve actual cases. Forensic goal is to identify the remains and to determine the circumstances of the unexplained death, and in this context, anthropologists are fundamental in the study of totally or partially skeletonized remains but also in cases where remains were altered by extraordinary conditions, such as fire, dismemberment or high-impact trauma. Part of the analysis that the forensic anthropologist can do is identifying the circumstances that lead to the discovery of the remains and determine what has happened to them since death. For that, gathering information at the recovery site is essential to help determine if the body moved or not, the time elapsed since death and indications of a trauma that may have occurred before, at or after death. As the main goal is to determine the identity of the person and to reconstruct the events surrounding his or her death, forensic anthropologists assess major biological characteristics of the remains. The first assessment that needs to be done when working with very incomplete and deteriorated remains is to define if they are bones and if they are human. In a second step, the remains themselves and context where they were found can help to determine if they are modern or not, this means that the remains could belong to a recently deceased person of forensic importance or to ancient populations from an archeological site. When the remains are human and recent, the assessment of major biological characteristics, such as age, sex and stature, help focus the investigation on specific groups. After that, individual biological characteristics, such as

pattern of dental restoration, evidence of previous trauma and medical conditions, or unusual biological characteristics could help reaching personal identification. Considering that the finding of remains suspected of being human set in motion the entire justice system and a lot of employees and professionals get involved in the resolution of the cases, forensic anthropology can make a huge contribution to the administration of justice in recent are cases suggesting the closure or derivation of those cases that are not of forensic importance and the continuation of the trial of the worthy ones.

Spatial distribution of stable isotopes as a tool in forensic investigations

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Assigning human remains to a specific region or population of origin is of utmost importance in forensic investigations. Stable isotope (SI) analysis of human tissues offers a tool to enhance the biological profile and reconstruct the movements of unidentified decedents, as well as to exclude possible matches and narrow search areas. The stable isotope composition of drinking water and foods are reflected in our bodies, recording geographic and dietary information. The capability to use SI as a provenancing tool depends on a thorough knowledge of their spatial distribution and the quality of the data used in building the foundational predictive models. Here we present geographic patterns of SI distribution to discuss their use in forensic analyses. We focused first on how O and H isotope ratios vary across the landscape and how a process-based model developed for the USA can be applied to predict geographical origin of samples. Second, we present the spatial distributions of dietary isotopes (C, N, S) that could be used to distinguish regions, populations and individuals.

Individual identification by means of DNA profiles comparison. a bayesian approach

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Forensic Genetics deals with individual identification by means of DNA profiles comparisons, between questioned samples and reference samples. The STR-based DNA profiles are build up using highly variable loci, where an array of short sequences are

repeated in tandem. Variability is based on the number of repeats, so that each variant can be automatically detected by capillary electrophoresis (based on its length). The DNA profile is defined by a panel of STR markers, combining the STR marker name and the observed variants. These features allow Database searching, a useful tool in massive investigations, not only to aid in solving criminal cases but also in disasters victims identification (DVI). However, the STR profile does not allow distinguishing coincidences that are identical in state (the fragment length) from that which are Identical by genetic linkage. Although this experimental limitation could be overcome using the sequence analysis (Next Generation Sequencing), up to date the commonly used methodology is based on STR-typing. Following the quality assurance standards, the DNA profile is a reliable and objective datum. However, the expert have to make inferences in the context of the quality of the retrieved profile, which in turn depends on the quantity and the quality of DNA in the starting material. To give an answer the Bayes probabilistic approach is used, considering two possible explanations to interpret the profiles match: identity match or random match. Probability is interpreted as a degree of belief, taking into account the prior probability (degree of belief before the analysis), the hypothesis under evaluation and the information. Under this focus, the validity of the information is crucial in human remains identification when the declared genetic linkage are used as reference, as is also the case of the prior probability estimated based on meta data (age, sex, location etc).

Report writing and court presentation

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This talk will cover the principles of how to interpret geoforensic evidence. It will cover how a report is written, structured and presented, for presentation within the Criminal Justice System in the UK. It will also discuss the fundamental differences between our legal systems worldwide, and focus primarily on the common law system in the UK. I will discuss how new types of evidence can be brought into consideration for use. The system in Argentina will be briefly discussed.

We invite you to attend
the 4rd Iberoamerican Seminar on
Forensic Geosciences, México 2019
We hope to see you there!.

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