

OX²⁰²⁰GVC

Oxford Geoheritage Virtual Conference

**OXFORD GEOHERITAGE VIRTUAL CONFERENCE
ABSTRACT VOLUME**

25-29 May 2020

Keynote Abstracts, followed by Abstract Volume

KEYNOTE – MONDAY

GEOETHICAL PRINCIPLES IN GEOCONSERVATION

Author: Prof. José Brilha - Director of the Centre for Applied Research in Earth Sciences, University of Minho

ABSTRACT:

Geoconservation and geoethics are two emerging themes that have been gaining prominence in the international geoscientific community during the last couple of decades. However, there are still few papers that discuss how and why geoconservationists should follow geoethical principles or whether geoconservation has to deal with specific geoethical values, in comparison with other geoscience domains. As geoconservation is essentially an applied geoscience with strong connections with several sectors of the society, it is important that ethical, cultural and social values are taken into account in the various fields of activity of the geoconservationist, that include actions in protected areas, UNESCO World Heritage properties, UNESCO Global Geoparks, in local environmental education or geotourism projects, among others. This communication intends to raise awareness of the geoconservation community about the importance to pursue geoethical principles in the conservation of geological heritage.

KEYNOTE – TUESDAY

GEODIVERSITY: REDUNDANT TERM OR EVOLVING, MULTI-FACETED, GEOSCIENCE PARADIGM?

Author: *Prof. Murray Gray - Honorary Professor of Geography, Queen Mary University of London*

ABSTRACT:

The term ‘geodiversity’ was first coined in the early 1990s and early development of the concept and principles was by Tasmanian workers. However, most criticism of it has come from geologists in mainland Australia. In a recent paper in the Australian Journal of Earth Sciences, Margaret Brocx and Vic Semeniuk stated that “use of the term geodiversity to refer to the ‘whole of Geology’ is a redundant use of the term and is self-evidentiary” since geology is known to be diverse. They also regard geodiversity as:

- ‘region-specific and site-specific’ and not global;
- a side issue and not part of the main relationship between geology, geoheritage, geoconservation, geotourism, etc.;
- related to ‘understanding and managing the biodiversity of a region or locality’.

This presentation will counter these claims by outlining several of the advantages of the concept including:

- celebrating geological and geomorphological diversity;
- focusing on how geodiversity benefits society;
- acting as the backbone of geoheritage and geoconservation;
- being a fundamental foundation for geotourism and geoparks;
- supporting sustainability principles.

In response to Brocx and Semeniuk, it is concluded that:

- geodiversity is a global concept, not just regional and local;
- geodiversity deserves to have an absolutely central position in the relationship between geology, geoheritage, geoconservation, geotourism, etc.;
- as well as underpinning biodiversity, geodiversity is the source of many other ‘geosystem services’;
- and therefore that geodiversity is a significant, evolving, multi-faceted, geoscience paradigm.

KEYNOTE – WEDNESDAY

INTEGRATING THE CONSERVATION OF GEOLOGICAL, BIOLOGICAL AND CULTURAL HERITAGE: CHALLENGES AND PROSPECTS

*Author: Prof. Heather Viles - Professor of Biogeomorphology and Heritage Conservation,
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ABSTRACT:

Heritage conservation is of increasing importance in a world where human connections with land, life and history are under threat from a wide range of environmental, social and economic changes. Many different approaches to heritage conservation have been trialled over the past 50 years, usually focusing on either cultural heritage or biodiversity, with conservation of geoh heritage relatively neglected until recently. Increasingly however, today's heritage conservation at local, national and international scales is seeking cost-effective approaches which can both integrate different aspects of heritage, and link heritage conservation with attempts to tackle major global challenges. But what are the challenges of such an integrated vision for heritage conservation, and how might it enhance the conservation of geoh heritage? I address these themes through the lens of a case study of the Isle of Portland, Dorset, UK.

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OXFORD GEOHERITAGE VIRTUAL CONFERENCE ABSTRACT VOLUME

25-29 May 2020

Abstracts are arranged in alphabetical order, using the presenting author's name as submitted. All details, including the abstract, are printed as submitted.

Times correct for Oxford, UK (BST = UTC+1)

Please note that due to demand, the conference has been extended to include Friday 29th May

ASSESSING THE EFFECTS OF THE ISLE OF ARRAN'S (SCOTLAND, UK) NEW GEOPARK STATUS ON TOURISTS' KNOWLEDGE OF GEODIVERSITY AND LOCAL ECONOMIC DEVELOPMENT

Presenting Author: *Abigail Brook-Petty, York St John University*

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Dr Joseph Bailey, York St John University

Day: Tuesday

Session Number: 3

Time: 15:00

ABSTRACT:

Geotourism is of growing interest to communities who live in areas that feature geological sites of interest. Arran is described as “Scotland in miniature”, due to its high geodiversity, and gained geopark status in 2019. This research aimed to assess the social aspects of the establishment of the geopark on locals and visitors. Indeed, whilst 147 UNESCO geoparks have been established worldwide, few studies have focused on the local people and businesses in the context of the geopark’s role in tourism.

We were particularly interested in geotourists visiting the island and local economic development as both will play an integral role in evaluating the geopark’s success. Questionnaires were carried out to establish potential local economic development, as well as gauge tourists’ understanding of geodiversity and their expectations of educational tools provided on the island.

Results included a lack of understanding of local geodiversity from tourists, however enthusiasm to improve this was shown by the majority. This is particularly important considering many of the tourists did not visit the island for its geology and anything related to geodiversity was often new to them. For tourists, engaging with a wider range of educational tools would aid their understanding and the geopark does provide opportunities for this which are overlooked by visitors. Current usage is limited to traditional tools but there is scope to improve on this with technological advances making learning easier than ever.

Businesses were able to see the potential economic benefits of the geopark status. Diversification of their business models will allow them to meet demands placed on them by the geopark’s presence, however a lack of understanding regarding how their business is compatible with the aims of the geopark is hindering progression. The recognition of their industry in the context of geosystem services, particularly provisioning and cultural services, would also benefit them. This could involve recognising the island’s natural resources or the

cultural significance of its diverse landscapes. However, these currently seem to be undervalued by businesses.

These findings will likely go some way to assisting the geopark as it develops by emphasising the importance of communities and tourists to both Arran Geopark and future new geoparks. By explicit consideration of tourists and the local economy, we can ensure existing and new geoparks benefit as many people as possible.

**THE ROLE OF GEOARCHAEOLOGY AND GEO-
HISTORICAL DATA
FOR URBAN GEOMORPHOLOGICAL HERITAGE
ASSESSMENT:
THE GEOTOURIST ENHANCEMENT OF ROME.**

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Day: Wednesday

Session Number: 5

Time: 14:45

ABSTRACT:

In the context of urban geomorphological studies concerning Rome, this research aims to deepen the geoarchaeological knowledge of the area and to analyze its impact on the value of geoheritage. What is meant by millennial human presence in the Rome area? What transformations to the original landscape took place in pre-Roman and Roman times? the contribution of archaeological studies is fundamental for the reconstruction of the original landscape of the area occupied by the city of Rome. Does the assessment of geoheritage in urban areas suffer from the cultural value of the sites? The current geoheritage assessment methods do not investigate this aspect, which is why among the research objectives there is the definition of the quantitative assessment of urban geosites, in the light of geoarchaeological and geo-historical data. The results of the work will be integrated into the geomorphological map and the urban geosites inventory of Rome, which will be enriched with layers specifically related to geoarchaeology. The data of the geomorphological map of Rome will allow the implementation of the geotourist map, a tool for the dissemination of geomorphological and geoheritage research results. The significance of this study lies in encouraging the dialogue between geomorphological and archaeological studies concerning Rome and in taking advantage of the potential of multidisciplinary data. This research will contribute to geoheritage studies, which will see a step forward in the objective evaluation of geosites in the urban areas and in the geotourist mapping.

The project topics benefit of the international scientific community's vivid attention, we are looking for collaborations, don't esitate to ask more about the project!

PEDODIVERSITY AND GEOMORPHODIVERSITY: A MEANINGFUL INTERRELATION WITHIN MOUNTAIN CATCHMENTS

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Day: Tuesday

Session Number: 3

Time: 14:55

ABSTRACT:

Hydrographic basins in mountain regions are characterized by a spatial variability in terms of bedrock and structures that is reflected in the geomorphic dynamics and related landforms. Furthermore, the relation of geological and geomorphological parameters with soil development is evident in these environments. Geodiversity in general, including both geomorphodiversity and pedodiversity, and considering not only elements but also relations and reciprocal dynamics, function as a substrate for biodiversity and becomes relevant in high naturalistic vocation area. In the high altitude environments, where differentiation in bedrocks and, consequently, in geomorphic processes, confers a very impressive diversification in the landscape and in the potential geoheritage, also soils could contribute to the naturalistic value of the area. A discussion is open starting from the analyses in progress in the Veglia-Devero Natural Park (Lepontine Alps), and in particular within a small mountain hydrographic basin (the Buscagna stream catchment). This area has been studied since a long time for what concerns biodiversity, and it is under the focus for geomorphodiversity. The great diversity of soil forming factors, in a such relatively small area, can provides a relevant range of soil types, which not only contribute to the pedodiversity, but also help in discovering geomorphological formative events occurred in the area. In this sense, soils become natural assets of a certain cultural value as pedosites. The work is focused on the importance of soils as central element aimed at expanding the concept of geoheritage/geoconservation, and linking to geomorphodiversity and biodiversity concepts.

INCORPORATING URBAN GEOSYSTEMS INTO GEOCONSERVATION INVENTORY PORTFOLIO IN THE AUCKLAND VOLCANIC FIELD, NEW ZEALAND

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Day: Monday

Session Number: 2

Time: 15:40

ABSTRACT:

Geodiversity is the foundation of geoheritage because it reveals all the potential high scientific value areas. The connection between geodiversity and geoheritage lies within the concept of geosystem services. Geosystem services are the benefits society obtains from geoconservation. These benefits are not instantly measurable therefore it is crucial to develop an enduring framework around which to organize and manage associated activities. Land protection is a difficult decision-making task under rapidly increasing pressure of urban sprawl. The Quaternary Auckland Volcanic Field has provided research areas to advance our understanding of monogenetic volcanism. Volcanoes of Auckland are under risk of vanishing due to the nonexistence of generally accepted method to incorporate geoheritage into land use planning and quantifying their value for comparability. In terms of recreational values, the volcanoes in the city centre provide popular escapes from the busy city. Providing they have cultural and recreational values they are granted protection. There is no tool, however, to assess if their scientific significance is in line with the protection status in power. Quarries situated outside of central Auckland expose inner structures of volcanoes and provide deeper insight into the processes that knowledge underpins today`s volcanic hazard assessments. A GIS-based evaluation framework presented here ensures to express the geoheritage value of these locations. Our study focuses on urban geosystems of an active monogenetic volcanic field and illustrates how geodiversity is measured and integrated into geoheritage site prioritization. To incorporate geodiversity into existing geoconservation inventories we use meaningful spatial units and map the distribution of them. Urban geodiversity mapping in

GIS is compatible with urban planning resulting in the proposal of the most favourable land use. Furthermore, a geodiversity map sheds light on the overlapping values between different conservation areas, such as cultural heritage and biodiversity. The geodiversity of a monogenetic volcanic field such as the one in Auckland is highly underrated. The geoscientific values often lose their importance to biodiversity or cultural values. Highly researched areas with the most representative geological exposures commonly overlap with rather industrial areas. Without an evidence-based geoconservation approach geoheritage favouring measures cannot be taken in such environments.

A BOTTOM-UP APPROACH TO THE PRESERVATION OF PALAEOONTOLOGICAL HERITAGE – THE ROLE OF LOCAL ASSOCIATIONS IN THE ASPIRING GEOPARK OESTE (PORTUGAL)

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Day: Thursday

Session Number: 8

Time: 15:25

ABSTRACT:

Portugal is known for a range of fossil findings, with dozens of fossil species described for the first time from its fossil record. The Palaeontological heritage is legislated in the Portuguese Law in association with the Archaeological heritage. While the protection laws and procedures are well defined for the Archaeological materials, fossils are clearly under regulated, leading to a void in fossil protections. An exception to this is protected areas, such as Natural and National parks, where legislation protects all kind of heritage, including geological and paleontological heritage.

Within the Geoheritage identified at the Aspiring Geopark Oeste (West Central Portugal), we highlight the importance of the vertebrate fossil record, for its international relevance and high interest for the general public. Among these fossils, a huge quantity of dinosaur fossils has been retrieved from the Lourinhã Formation, a set of Late Jurassic fluvio-estuarine to lagoonal rocks. These are the majority of outcropping rocks in this Aspiring Geopark.

In the lack of public laws to safeguard Palaeoheritage, local associations have been working for the preservation of fossils. In the Aspiring Geopark Oeste, at least 5 local associations have played this role, from which we highlight the work of the “GEAL - Grupo de Etnologia

e Arqueologia da Lourinhã” and the “SHN - Sociedade de História Natural”. These two associations, created in 1984 and 1998 respectively, work on collecting, preserving, studying and promoting local heritage, including Palaeoheritage. These two associations have a recognized public utility, and are supported by the municipalities at which they are based. The municipality support is done in multiple ways, via direct financial support, giving spaces for activities development and also logistic support to preserve local heritage.

These two associations, composed by anonymous people, scientists and politicians, have been collaborating with local authorities for the preservation of fossils. One of the approaches, in the absence of a national specific law, has been through the proposal of local protection laws and regulations, in a bottom-up approach. Also, both associations have been important seeds for the idea of implementing a Geopark in the region, and now will continue to support and suggest policies, safeguard actions and the promotion the local heritage, with particular emphasis on Paleoheritage.

CAJÓN DEL MAIPO ASPIRING UNESCO GLOBAL GEOPARK, CENTRAL CHILE: OUTSTANDING GEOLOGICAL HERITAGE AS A TOOL FOR LOCAL DEVELOPMENT

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Day: Friday

Session Number: 11

Time: 16:05

ABSTRACT:

Cajón del Maipo aspiring UNESCO Global Geopark is a territory located in the commune of San José de Maipo, in the Metropolitan Region of Santiago, Chile, and limits to the east with Argentina. It has an area of ~ 5,000 km² where less than 20,000 inhabitants live, occupying about one third of Metropolitan Region. In the remaining area is located the city of Santiago with its more than 7,000,000 inhabitants, less than 50 km away.

It is a mountainous area, which reaches its maximum altitude at 6,570 m.a.s.l, and its morphology is controlled by the subduction regime between the Nazca and the South American tectonic plates. In its rocks, more than 160 million years of geological history are recorded, and its geodiversity includes: sedimentary and igneous rocks, three active stratovolcanoes, thermal springs, more than 600 glaciers, tectonic structures, and one of the oldest mining poles in Chile. Its geology has been widely studied by scientists during more than 50 years. The first geological study registered in the area was carried out by Charles Darwin in 1835. Currently, exists an inventory of 40 geosites with scientific, didactic and touristic interest, 5 of which are included in the National Inventory. Cajón del Maipo has been declared the "Geological Capital of Chile" in 2018, initiative supported by local and regional authorities.

The area is part of the Chilean biodiversity hotspot, with a high mountain ecosystem with wildlife species such as condors, pumas and guanacos. There is a total of three protected areas, which together cover more than 200 km². It has archaeological sites and architectural heritage sites related to the old railroad and the mining activity. The intangible heritage is related to the geological environment, and includes ancient Andean crafts, such as muleteers, small artisanal miners and granite quarrymen. This territory is one of the most visited tourist destinations in Chile, so there are numerous accommodation and restaurants, as well as nature tourism and heritage tourism experiences.

In this context, since 2017 local and regional actors are working for the declaration of the Cajon del Maipo as a UNESCO Global Geopark, initiative supported by public and private actors, academics and community representatives. One of the main goals of this project is to provide opportunities for sustainable economic development to local community, by utilizing local heritage, especially geological heritage to develop geotourism experiences.

CARPATERRA`STEPS TO BUILD A GEOPARK

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Day: Thursday

Session Number: 9

Time: 16:40

ABSTRACT:

In the center of Romania you can find a small mountain range covered by pristine forests called the Per?ani Mountains. Beside different geological settings, here are some of the youngest volcanoes from Southeastern Europe which are the main attractions for scientist but also for tourists. During the last 60 years in this area 9 small geological protected areas have been established. Unified, this geosites can create an ideal educational platform for teachers, students but also for visitors.

Our association (Carpaterra NGO) was founded in 2009 in order to develop a geopark in this area.

The geopark idea was a new conception for the local communities and governments and because of this we encountered resistance from the beginning with local governments when we were looking for a partnership. They have refused to be part of this project. Their fear was mainly related to possible new regulations that could be imposed in the area and thus could no longer exploit the stone, the forests or pastures. Given their refusal we withdrew a little but we didn't gave up. The Carpaterra NGO began to develop projects funded by grants in three areas: environmental protection, cultural development and education of young people in the villages.

Through environmental projects we managed and surveyed 6 protected natural areas. For some of this areas were given strict protection (ex. the virgin forests in a Natura2000 site), others were made known nationally through a continuous promotion like the volcano from Raco? – Raco? Geological Complex or the 900-year-old oak from Mercheasa - The Elder of the Carpathians.

Through cultural projects we have developed annually 2 thematic festivals since 2016 and we also have organized several thematic exhibitions. The educational projects through which we have developed different activities with local schools represents another important achievement. As a result of these projects, today our association is very well known locally and it has become a reliable partner of the authorities.

Our goal is to become a member of the UNESCO Global Geopark network in the near future. The defined area will include 9 geological sites, 3 birds protected sites, 6 biodiversity sites and all the nice communities with their rich cultural heritage. United under the “umbrella” of a geopark the area will be able to develop coherently and more quickly.

LA ISLA DE OMETEPE: A POTENTIAL GLOBAL GEOPARK

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Day: Thursday

Session Number: 9

Time: 16:55

ABSTRACT:

La Isla de Ometepe, Nicaragua, is a spectacular double-volcano island in Lake Nicaragua. Maderas and Concepción volcanoes are geologically significant examples of large stratocones deformed by strike-slip tectonic movement, gravitational spreading and intrusion of magma. Within the scientific community, the debate persists as to how significant each process is, but all agree that the geology exposed on Ometepe is exceptional. The island already contains a UNESCO Man and Biosphere reserve, and for the last few years we have been considering the organisation of a geopark. A geopark would potentially increase residents' resilience to both socioeconomic and geologic hazards through the promotion of geoh heritage. Promoting geoh heritage could contribute to sustainable tourism development and increase awareness of geological risks and mitigation strategies. The geosite mapping that we have begun for the geopark can also be integrated into risk mapping. While we scientists can make the fundamental geosite descriptions and inventory, it remains a challenge to incorporate this with essential local knowledge and expertise, and accommodate geotourism planning to the very particular local conditions. We recognize that a geopark would exist within the complex, social-ecological system of the island. In 2017-2019, island residents joined in a study to conceptually map the social-ecologic system of the island, helping to identify some of the key issues that need to be faced in building a geopark project. A planned workshop on the island was postponed in March of this year, but our long-term project will continue to advance despite the coronavirus pandemic and an ongoing socio-political crisis within Nicaragua. We present the potential of the Island as a UNESCO Global Geopark and a concept map of the social-ecologic system of Ometepe.

GEOSITES AND GEOTRAILS OF THE SESIA VAL GRANDE UNESCO GLOBAL GEOPARK: INVENTORY AND POTENTIAL IMPLEMENTATIONS

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Day: Wednesday

Session Number: 5

Time: 15:00

ABSTRACT:

The present research focuses on the Sesia Val Grande UNESCO Global Geopark (Western Italian Alps), one of the most recent Geopark admitted in 2013 in the European Geopark Network, and revalidated by UNESCO in 2018. The main aim of the study is to illustrate the variety of geotouristic proposals in the territory of the Geopark according to: i) Geodiversity of the Geopark territory; ii) different approaches to Geoheritage valorization. Moreover, we tried to identify potential areas and topics to be implemented within the Geopark based on Ecosystem services offered by Geodiversity.

A list of 18 geotrails is provided, interrelated with 68 geosites and 13 off-site geoheritage elements (e.g. museums, geolabs). Most of the geotrails are equipped with panels, and supported by the presence of thematic laboratories or section in museums. A multidisciplinary approach (e.g., history, ecology) is applied to some geotrails, a few being translated into virtual tours, based on App for mobile devices. The analyses of the Geopark geosites revealed a diversity of bedrock lithotypes (magmatic, sedimentary, carbonatic, and metamorphic). Geosites of geomorphological interest include glacial and periglacial features, landslides and deep-seated gravitational deformations, karst superficial morphologies and caves, alluvial deposits and fluvial landforms as well as small alpine lakes and a large piedmont lake. Geosites also offer a selection of man-made landforms due to marble historic quarrying, soapstone archeological quarrying, and abandoned mines.

It emerges that the Sesia Val Grande UNESCO Geopark is an area characterized by high geodiversity, rich geoheritage and multifold geotourism opportunities, mainly derived by ecosystem services of cultural and knowledge character. Nevertheless, up to now, it appears that: i) geosites are lacking in some areas; ii) along some geotrails no geosites are up to now identified; iii) some geosites are not even linked through specific geotrails. Hence, among the perspectives for the future there is, on the whole, the implementation of valorization initiatives by means of upgrading the geosites inventory and geotrails proposals and by proposing also virtual approaches for some of them, considering the easy accessibility and high educational value.

CLASSIFICATION SCHEME FOR INVENTORY OF GEOMORPHOSITES: APPLICATION TO THE PROPOSED GEOPARK COSTÕES E LAGUNAS, RIO DE JANEIRO, BRAZIL

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Day: Monday

Session Number: 2

Time: 15:20

ABSTRACT:

The inventory of geosites is the first step for the establishment of geoconservation strategies. Especially when dealing with large and geodiverse territories, organizing the inventory under a systematic database may be a difficult task. The definition of geological frameworks and a clear classification scheme for the sites are valuable tools within this context, since they standardise the insertion of sites and allow, for instance, the creation of selection filters by attributes. The objective of this work was to propose a classification scheme for geomorphosites in the territory of the proposed geopark Costões e Lagunas (Portuguese for Cliffs and Lagoons), in the east and north coasts of Rio de Janeiro State, Brazil. The territory embraces 16 municipalities, with a total area of about 10 thousand km². Due to the high geodiversity, the territory has geosites representing several typologies (e.g tectonic, petrological, speleological, palaeoenvironmental, geomorphological, hydrogeological etc.), which are the basis for the definition of frameworks for the inventory of geosites. Within the framework of geomorphosites, some specific issues had to be tackled because this category presents some peculiarities: the imbrication of spatial and temporal scales, and the dynamic and aesthetic dimensions. Our classification proposal is based on the acknowledgment of these peculiarities, being divided into three major keys: Spatial, Thematic and Temporal. First, due to the imbrication of spatial scales, the geomorphosites had a Spatial Classification, being represented as points, lines or surfaces, and considering the number of different forms and related processes, being considered single landform, group of landforms, geomorphologic complex or geomorphologic system. Second, the geomorphosites had a Thematic Classification, divided into forms (e.g fluvial terraces, coastal dunes, coastal massifs) and processes (e.g aeolian, fluvial, coastal, tectonic). And third, the Temporal Classification was included, in which the geomorphosites are classified as active, inactive or as evolving passive geomorphosites, considering the dynamic dimension. Due to the

imbrication of temporal scales, some sites may be representative of both active and inactive processes. This classification scheme showed to be appropriate for organising the database taking into account the peculiarities of geomorphosites in their characterisation procedures.

GEOHERITAGE AS A GATEWAY TO DEVELOPING A CONSERVATION ETHIC IN HIGH SCHOOL STUDENTS FROM CHINA AND THE UNITED STATES

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Day: Friday

Session Number: 10

Time: 14:15

ABSTRACT:

A recent summary of geoheritage and protected area management (Gordon, 2019) notes that a broader discipline has been emerging in geoheritage that recognizes the links to landscape and biodiversity conservation, economic development, climate change adaptation, sustainable management of land and water, historical and cultural heritage, and geotourism. Our focus in this study is to emphasize that geoheritage can serve as a gateway to developing a broader conservation ethic by developing educational programs that have a broader aim of interpretation, education, and enjoyment. Ultimately these enjoyable educational experiences in areas of geoheritage value lead to a deeply felt conservation ethic. The US National Park Service recognizes the progression as “through interpretation, understanding; through understanding, appreciation; through appreciation, protection” (Tilden 1957).

We have been working towards this goal through the expansion of a high school environmental education program in the United States, the National Conservation Foundation Envirothon, to China. The Envirothon is an environmental education program that culminates in the annual NCF-Envirothon Competition in which winning teams from participating states and Canadian provinces compete for recognition and scholarships by demonstrating their knowledge of environmental science and natural resource management. Much of the field education and field competitions are held in areas protected for their geoheritage and biodiversity values, and this use of geoheritage as a gateway to the broader educational goals is central to the program.

We have been seeking to broaden the influence of the Envirothon program and underlying conservation goals in China. With educational curriculum reform since 2000 in China, students are encouraged to have more project-based learning opportunities and field-based experiences. The group at Beijing Normal University supports hundreds of high school partner programs. The Envirothon is a natural extension of this work and provides enhanced opportunities for international collaboration between the United States and China. Geoheritage value is a primary determinant of which areas are used for Envirothon field

education and competitions; through this gateway students from both countries will have educational, fun, and memorable experiences that will lead from understanding to appreciation to protection.

THE “HIDDEN” GEODIVERSITY IN THE TRADITIONAL APPROACHES ON ECOSYSTEM SERVICES: AN OVERVIEW

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Day: Thursday

Session Number: 7

Time: 14:05

ABSTRACT:

Ecosystem services are the goods and services provided to society by nature. Traditional approaches focus on biotic elements and only recently has the role of geodiversity started to be discussed. However, even when not named, abiotic elements are the focus of much research. This study intends to detect which and how these elements have been approached, to demonstrate the relevance of geodiversity in research on ecosystem services.

The following methods were used: 1) Initial search with papers written in English and published in scientific journals and use of the keyword “Ecosystem Services” added to specific terms: Abiotic; Rocks; Lowland + Sediment; Mangrove + Sediment; Beach + Sand; Beach + Sediment; Groundwater; Fossil; Mineral; Geomorphology; 2) systematization of the data based on the Essential Geodiversity Variables (EGVs); 3) Final selection that abstracts to identify articles that focus on elements of geodiversity and exclusion of articles that contain the term “geodiversity” and that do not use qualitative or quantitative methods.

As a result, it is noted that the articles were published after the 2000s - initial search (397) and final selection (154 - 39%), with a significant increase after 2010, with an average of 14.3 published articles/year. When classifying articles according to EGVs, there are: Geology - hardrock, fossil & mineral (25%); un-consolidated deposits (18%); geophysical processes (1%); Geomorphology - landform distribution (15%); Solo - chemistry (6%); physical state (3%); Hydrology - surface water (14%); groundwater (18%). Research using the term “geodiversity” (2.3%) only appears after 2010.

These results show that, although specific research on the role of geodiversity is still incipient, several abiotic elements have been focused on studies on ecosystem services. The EGV with the highest percentage (25%) is “hardrock, fossil & mineral” as this variable embraces most of the elements of geodiversity (rocks, minerals and fossils). Systematization according to EGVs is important because it can guide future research that aims to understand the ecosystem services provided by geodiversity, as well as to value their losses. Although much research on ecosystem services does not address the abiotic part of nature, this scenario has changed because, without the contribution of geodiversity, many of the ecosystem services would not exist, since the ecosystem develops by the interaction between biotic and abiotic elements.

A NATIONAL GEOHERITAGE DATA SET FOR IRELAND BASED ON COUNTY-LEVEL AUDITS OF SITES OF GEOLOGICAL SIGNIFICANCE.

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Day: Thursday

Session Number: 7

Time: 14:10

ABSTRACT:

Geological Survey Ireland (GSI), in partnership with the Heritage Council, local authorities and the National Parks and Wildlife Service, has a programme of identifying those sites that best represent the geological heritage of Ireland. The programme aims to establish a national, maintained data set that can support statutory bodies in meeting their obligations in relation to geoheritage and ultimately, lead to designation of geological Natural Heritage Areas.

In phase one of the programme, sites were selected under 16 different geological themes by panels of experts. For each theme, the scientifically most significant sites were selected for an initial national list of 'indicative' sites.

In the second, ongoing phase, sites from the 'indicative list' and other sites if deemed of local geological significance are 'audited', inspected and assessed for suitability as County Geological Sites (CGS). A report is written for each site in non-technical language, including details of recommended site management and suitability for access or promotion for the general public.

Upon completion of a county audit, a volume of the selected site descriptions is published and the local authority planning department includes a listing of CGS in the County Development Plan (CDP). Through the planning process, protection of the sites against potentially damaging developments is provided. Public consultation on the CDP allows stakeholders in the sites and the local community to 'buy into' the process. In many cases, CGSs are sites of high amenity or educational value, already recognised in local cultural and heritage plans. Geological Survey Ireland works with the local authorities in the production of museum displays, popular science books, and education content for the further promotion of sites after the completion of the county audit.

To date, the geoheritage programme has completed the audit process for 25 of the 31 local authority areas or counties of Ireland. Upon completion, a national data set will document

Ireland's best and most significant sites of geological interest and hopefully ensure their protection into the future.

THE GEOSITES OF ASKAR AND TABAROUCHT (HIGH ATLAS OF BENI MELLAL) : A GEHERITAGE DIVERSITY IN FAVOR OF GEOTOURISM

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Day: Wednesday

Session Number: 5

Time: 14:50

ABSTRACT:

In recent years, the concepts of geo-heritage, geotourism and geoconservation have evolved a lot in Morocco, especially with the labeling of the M'goun geopark by UNESCO in 2014 and 2019 and the appearance of the first law for the protection of geoheritage launched in August 2019 As well as the publication of several inventories of geosites which have been carried out in different regions of the kingdom. In this communication, we will present the Askar and Tabaroucht geosites located approximately 60 km from the town of Beni Mellal.

The Askar geosite, located about 15 km south of the village of Taguelft, offers real geotourism opportunities characterized by waterfalls, beautiful panoramic views and picturesque mountain ranges formed by vertical limestones from the Bin El Ouidane 3 formation. these are pleated and verticalized oncolite limestones in the NNE-SSW direction with intersecting stratification. In addition, the site contains a precious magmatic heritage marked by a greenish gabbroic intrusion and several dykes of around 2m thickness and direction NW 310, forming part of the radiating dikes of the Taguelft syncline. Without forgetting the architectural potential of this Berber village which includes a large number of fortified community granaries.

The magmatic geosite of Tabaroucht is located about 60 km from Beni Mellal and 18 km from Askar, it is marked by three dark basaltic flows separated by silts and sandstones from the Gettioua formation of Bathonian age, these sometimes vacuolar flows are cut by centimeter-thick dykes. Also, this geosite offers beautiful panoramic views of the tabular structure of Jbel Sgat, the Taguelft syncline and the meandering aspect of the Oued El Abid bed. A monk of 2 km to the East, the visitor can perceive a marvellous karst source which originates within the lites and verticalized limestones of the Bin El Ouidane formation. The source feeds the Oued Assif-n-Tabaroucht which carved the limestone of the Bajocian by forming a very beautiful gorge.

Unfortunately, this heritage diversity suffers from threats linked essentially to human activities, particularly those linked to road construction and mining, while it deserves to be preserved and transmitted to future generations. Indeed, the preservation and promotion of this heritage requires the adoption of an approach which combines scientific importance with natural, economic and social resources, ultimately leading to sustainable tourism of an educational nature

POTENTIAL PALEOCLIMATIC GEOMORPHOSITES IN THE INVENTORY OF THE NORTH COAST OF THE STATE OF SÃO PAULO, BRAZIL

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Day: Monday

Session Number: 1

Time: 14:45

ABSTRACT:

Geoconservation plays a vital role in the conservation of geodiversity and geological heritage. This perspective includes the paleoenvironmental records, which contributes to understanding the different climatic contexts of the Earth's past, and allow the development of models with future scenarios concerning human actions. Geomorphological sites are good examples that retain a record of the global changes in the past and present of the Earth climate. Especially in coastal zones, the marine deposits and the coastline may indicate the relative sea-level variations. Thus, this study aims to carry out a bibliographic review regarding the published paleoclimatic studies on the north coast of São Paulo State, Brazil, to select the potential geomorphosites to be included in the Geomorphological Heritage Inventory. The northern coast includes the municipalities of Ubatuba, Caraguatatuba, Ilhabela, and São Sebastião. This region has a relevant natural heritage concerning geodiversity, it includes geosites that represent the evolution of the Gondwana Supercontinent. This region is known as the most rugged coast in Brazil, containing the Serra do Mar and the coastal plain formations. The coastal plains were developed due to the sea-level variations during the Quaternary, and it was the main factor for the formation of the coastal morphology of the State of São Paulo.

The selection of preliminary geomorphosites was carried out based on the literature review. As a result, were identified 11 potential geomorphosites representing past and current climate change records. The next research steps will incorporate the field trip and the assessment of their values to verify if these potential geomorphosites will be include or not in the inventory. These sites consist of beachrock, Pleistocene and Holocene marine deposits, cliffs and exhumation on marine terraces, erosive features, embayment formation, destruction and burial of the mangrove vegetation. The identification of potential representative geomorphosites becomes relevant to enable the development of strategies that conserve these places in the face of urban growth. Besides, it allows the integration into management plans, aiming the conservation and use for teaching programs.

GEOTOURIST MAPPING AT VARIOUS SCALES TO ENHANCE GEOHERITAGE PROMOTION

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Day: Thursday

Session Number: 9

Time: 16:45

ABSTRACT:

Geotourism is a niche tourism at the interface of cultural and nature tourism. It is aimed at promoting regional geoheritage through various techniques of interpretation and popularisation of geoscience. Thus, multiple achievements (brochures and educational panels, digital applications) and services (guided tours) have been implemented. One of these is the realisation of geotourist maps, which are paper or digital documents that combine geo(morpho)logical information, oriented to the understanding of landscape history, and tourist information to facilitate the visit. Geotourist maps are multiple, from simple

orientation maps aimed at the localisation of geo(morpho)sites, to elaborated interpretative products with a clear educational purpose.

Two projects were developed at two different scales. (1) The Valais geotourism map project aims to provide a tool for discovering the geoheritage of the Valais region, in the Swiss Alps. This map represents remarkable geo(morpho)sites to which tourist information has been added (information centres, museums). It is intended to be representative of the richness of the region's geoheritage. A selection procedure made it possible to select 123 sites, on the basis of scientific criteria (interest in knowledge of the geo(morpho)logical history of the area), additional criteria (ecological, aesthetic or cultural value), accessibility (only sites that are easily accessible were selected) and educational interest (sites that are easy for tourists to interpret or the presence of educational materials). The map is produced in two forms: a paper map, to take to the field, and a digital map, available on the Internet, offering interactive consultation tools, using webmapping techniques. (2) The second project proposes a method for the design and representation of large-scale geotourism maps (at the scale of a geo(morpho)site) using Geographical Information Systems. It is based on an analysis of criteria for selecting data to be represented and symbolization to be standardized, and proposes guidelines that can serve as a basis for large-scale geotourism mapping based on geomorphological mapping. The resulting legend was tested at two study sites: the K'hil region on the Dahar plateau in south-eastern Tunisia and the Hérens valley in the Swiss Alps. In contrast to the assessment of geoheritage, geotourism mapping has not yet undergone much methodological development. These two projects attempt to partially fill this gap.

FROM MINERAL DEPOSITS TO GEOTOURISTIC RESOURCES: THE ENHANCEMENT OF ABANDONED MINES IN THE ITALIAN ALPS

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Day: Thursday

Session Number: 7

Time: 14:15

ABSTRACT:

Since the 2nd WW most of the ore deposits in Europe, and in particular in the Alps, faced a progressive closure of mineral exploitation. During the last decades, many abandoned mining areas started to live a new life from a touristic and cultural point of view: many are the mining museums and "mining parks" born on the wish to maintain the historical memory about the hard work of miners, the mining engineering techniques and the geological knowledge development in mines and quarries.

Old mines are, in the popular imagination, a place full of mystery and adventure, and the rehabilitated ones are the ideal destinations for people looking for non-conventional touristic topics.

The customers of mining museums and mining parks (with surface and underground tours) are very variable: families, schools, university students, researchers, enthusiasts, historian, but even curious tourists.

In Italy we have many examples of mining museums and mining parks, working at different level (local to national, inside specific networks), and new projects are coming, with the help of EU founding opportunities, the support of national and international networks about heritage (industrial and geological) and new laws about mining and quarry activities, which have specific articles about the abandoned mines and quarries, and their use for cultural and touristic purposes.

“RUTAS DEL SILLAR” GEOSITE FOR GEOHAZARD RESILIENCE IN LOCAL COMMUNITIES OF AREQUIPA, PERU: QUANTITATIVE ASSESSMENT AND COMMUNITY WORKSHOPS

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Day: Wednesday

Session Number: 6

Time: 15:20

ABSTRACT:

Arequipa is the second largest city of Peru. In the last decades it has had accelerated population growth and unplanned urban expansion, which has led to the settlement of ~250,000 inhabitants in hazardous areas close to the active El Misti volcano, and the dormant Chachani volcanic complex. In 2017, the colonial architecture of the city has been recognized as UNESCO World Cultural Heritage. The buildings are made of volcanic rock locally called as sillar, quarried from Arequipa Airport Ignimbrite deposits.

The ‘Geoheritage for Geohazard Resilience’ project of the UNESCO International Geosciences Program, aims to use geoheritage to build resilience in communities at risk from natural hazards worldwide. The sillar quarry located on the northwest side of the Arequipa city is one of the areas selected as geosite. The deposits are cut by numerous ravines which can be subdivided into different classes according to their state of degradation: natural, little touched, tilled and very altered. They are dry most of the year, but they can flood and host debris flows in the rainy season (January-February).

The first results to assess geoheritage using the Brilha et al. (2015) method reveal the highest score for potential touristic use for the Añashuayco and Culebrillas ravines. A score up to 350

for degradation risk is found for the Uchumayo ravine and the highest score of potential educational use is found for Añashuayco ravine, due to higher scores in safety and logistics. The method of Reynard et al. (2016) show highest scores for all criteria are obtained for Añashayco and the lowest scores for Uchumayo. Los Andenes and Culebrillas ravines obtain the highest scores for ecological, cultural and aesthetic values. The Cendrero (1996) method gives a high score for Añashuayco in base of its large size, Pleistocene age, close relation with archaeological, historical, artistic elements and good conservation state.

In order to develop a participatory approach of the project, we have made two workshops with the stoneworkers' association of Añashuayco quarry, with the purpose of understanding what brings or does not bring benefits for them. It is essential to test the participatory and scientific narrative in order to reach a balance and combine both versions to strengthen the project. We also suggest some lines of work, such as training or manuals for the quarryman association and tour guides, integrating the prevention of natural risks in the visiting programs.

GEOHERITAGE INVENTORY: ASSESSMENT OF METHODS AND APPLICATION TO THE PARANÁ STATE, SOUTHERN BRAZIL

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Day: Monday

Session Number: 1

Time: 14:50

ABSTRACT:

As in other countries, Brazil lacks a national inventory of its geological heritage, despite abundance of relevant geological sites. Some state geological surveys, such as the one in Paraná, have implemented interpretative panels in some sites recognized by the scientific community and/or with scenic beauty, aiming to show society the geological importance and encourage geoconservation. Places that are important records of the Earth's memory have been or are being destroyed by increasing urbanization and agriculture. There is also to consider the climate of tropical and subtropical regions that accentuates weathering, as well as the mismanaged and predatory use by tourists, and sometimes even specialists. This communication presents the preliminary results of the first inventory of geological heritage in the State of Paraná, developed as part of a PhD thesis at the Federal University of Paraná. In Brazil, on a state scale, only the State of São Paulo has its geoheritage inventory. The main inventory methods described in the literature were analyzed and adapted to meet the scale and peculiarities of the geological heritage of Paraná. Taking into account the stratigraphic and tectonic characteristics, the state of Paraná was divided into eight geological frameworks. The geological heritage is evaluated according to four parameters (scientific, didactic and touristic values, and vulnerability), described by 23 sub-items. New items were included, such as personal safety, natural and anthropic vulnerability, and carrying capacity. The database under development currently has about 250 potential geosites. Most of them are located in sedimentary rocks of the Paraná Basin, and many of them with fossils. The next stage of research was the application of the Delphi method, through which the sites initially recorded were evaluated and scored by experts in each area. After expert evaluation, 80 geosites were

finally selected for the next phase of quantification. The research aims at presenting a systematic inventory method, at the State scale, adjusted to peculiar conditions such as the degree of geological knowledge, access and conservation infrastructure. The results are fundamental for the implementation of a future geoconservation strategy of the state.

ARE LANDFORMS MEANINGFUL FOR BIODIVERSITY?

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Day: Tuesday

Session Number: 3

Time: 14:45

ABSTRACT:

The positive relationship between geodiversity and biodiversity has been explored and recognized in several landscape-scale studies. According to the theory, geodiversity and biodiversity should correlate positively also on local scale, but empirical evidence has been mostly lacking. In this study, we explore the relationship between landforms (elements of local-scale geodiversity) and vascular plant diversity at Rokua UNESCO Global Geopark area, Finland. Specifically, we seek answers to two main questions: (1) are there differences in biodiversity between distinct landforms (such as beach ridges, dunes or lake shores) and control sites (i.e. sites without any distinct landforms), and (2) how biodiversity varies among different landforms. We compare several vascular plant diversity measures for different landforms and control sites. The results show that landforms are, in general, more diverse than control sites. Moist, hydrologically and microtopographically variable landforms, such as gullies and river shores have especially high biodiversity. These results give empirical evidence that elements of local-scale geodiversity are meaningful for biodiversity. Furthermore, the results encourage both scientists and practitioners to explore and integrate local-scale geodiversity and biodiversity e.g., in further studies and in conservation planning.

THE PER?ANI MOUNTAIN, A SMALL GEOLOGICAL JEWELRY IN THE CARPATHIAN MOUNTAINS WITH A RICH GEOLOGICAL AND CULTURAL HERITAGE (ROMANIA)

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Day: Tuesday

Session Number: 4

Time: 16:40

ABSTRACT:

The Per?ani Mountain is located in the inner part of the Carpathian Bend Area, Northeast from the Bra?ov metropolitan area. Here is located the youngest (1.2-0.6 Ma) and probably the smallest monogenetic volcanic field in Southeastern Europe, the Per?ani Volcanic Field (PVF). The oldest exposed rock is the ~550 Ma old gneiss. It is an important territory from paleontological point of view as well, known especially for its Upper Jurassic to Lower Cretaceous Ammonoidea and Upper Cretaceous Inoceramus faunas. Most of the eye-catching and visited geosites are the ones related to the volcanism, which were exposed by quarrying. The Raco? Basalt Columns, the Heghe? Hill scoria quarry and the Brazi basalt quarry partially filled by the "Emerald Lake", the Hoghiz Basalt Micro-Canyon are the most spectacular geosites of the area offering beautiful viewpoints for the visitors. Other important sites are the The Mud Volcanoes from B?ile Homorod, Dopca Gorge, „B?rlugul Ursului" (Bear's Den) Cave, Rupea Basalt Cliff. The protection of this geological sites started in the 1950s. The last one was added last year. The complex geological structure provides an

excellent educational material on the formation of the Carpathian Mountains. The Per?ani Mountains' protected biodiversity is composed of five Natura2000 sites and one bird and fauna nature reserve. Another attraction is the approximately 900 years old oak from Merchea?a. The area has an exceptionally high natural (geodiversity & biodiversity) but also an important cultural heritage values with strong sustainable development potential. It has been inhabited since Paleolithic times which is witnessed by archaeological sites, medieval fortresses, castles and fortified churches. Even today in this territory ethnicities of Hungarians ~ szeklers, Romanians, and gypsies are living together which gives a special contemporary folklore to the region. The Carpaterra NGO together with the National Environmental Agency of Romania (<http://apmbv.anpm.ro>) and scientists from different fields made diverse progresses related to the protection, management, scientific evaluation, and sustainable development of the area. The region currently aims to be listed as an aspiring UNESCO Global Geopark developing a pathway to reach this status in the near future. The region is also part of the recently proposed European Volcano Route.

GEOCULTURAL HERITAGE IN URBAN ENVIRONMENT: THE EXAMPLE OF PAVIA - PAPIA CIVITAS GLORIOSA (CENTRAL PO PLAIN, NORTHERN ITALY)

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Day: Wednesday

Session Number: 5

Time: 14:55

ABSTRACT:

Geoheritage in urban environment is acquiring an increasing relevance as opportunity to approach Earth Sciences. In particular, the interaction between geomorphological processes and anthropogenic activities produces an impressive association of geomorphological and archaeological heritage in urban contexts. The urban geomorphology and the geocultural heritage in the town of Pavia (Northern Italy) are analyzed and proposed for geotouristic activities addressed to different kinds of audience. The evidences of the colonization since Iron Age (i.e., Gaul settlement) passing through Roman and Medieval Times are conserved, showing different approaches to urbanization. Urban development shows to be firstly adapted and then superimposed onto fluvial landforms. The city, in fact, is located in a strategic position, on a series of fluvial terraces. Landforms, partly conserved and hidden by human interventions, were analyzed through field and GIS-spatial analyses, including investigations on archaeological data and historical cartography. The result is a flexible geocultural itinerary, with geoeducational and geotourism purposes, aimed at linking the geoheritage with the cultural heritage, and at disseminating urban geomorphology key-concepts.

VIRTUAL TOUR TO TERRA DOS CAVALEIROS GEOPARK AS A TOOL FOR REGISTRATION AND EDUCATION IN GEOSCIENCES

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Day: Friday

Session Number: 10

Time: 14:20

ABSTRACT:

The most common way to promote geological heritage materializes through the use of maps, posters or informational murals, blogs, websites (Geoparks for example) and videos. This information is usually detailed and visually appealing. However, in most cases, there is little interactivity and lack of contextualization within the geographical space. The main objective of this work is to use information collected with Unmanned Aerial Vehicles (UAV's), georeferenced information processed in Geographical Information Systems

(GIS), photogrammetry techniques and multimedia technologies to promote a better integration, between reality and computer visualization of geological heritage. The use of UAV's allows not only the capture of a panoramic image, as well as the capture of land portions that can be converted, using photogrammetric techniques, into interactive 3D objects. This use enables a new way of viewing geological aspects that are not easily observable from the ground. All the information is aggregated in a website, using currently available technology, including the landscape interpretation language for providing 3D online.

as a result, a website was used with all the information aggregated and available on any mobile device or not: <http://www.dct.uminho.pt/macedo/macedo.html>

GEOCULTURAL SITES IN A VOLCANIC LANDSCAPE, A CONNECTION BETWEEN GEOLOGICAL AND CULTURAL HERITAGE

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Day: Wednesday

Session Number: 6

Time: 15:40

ABSTRACT:

The cultural landscapes evolved spanning through thousands of years of history but there were rapid societal changes in rural regions due to urbanization and related migration in the 20th century. The traditional cultural landscapes suffered a great loss in diversity, integrity and identity. Their heritage comprises tangible and intangible elements including anthropogenic landforms, historic, industrial, cultural buildings giving important resources for geoconservation. The cultural geomorphology studies identified material and immaterial elements of cultural landscapes and defined the geocultural sites where the geological features interact with cultural elements. Although these provide a good methodological basis

for processing special cultural landscapes, few detailed case studies are available in the literature

Our study was conducted in the northern part of volcanic Tokaj Mountains (Hungary, Central Europe) stretching north to Slovakian border including 44 settlements with an area of 700 km². The mountain range is a special mountainous cultural landscape determined by its historical, mining-industrial and agricultural (forestry) traditions. A major aim of this study was to identify geocultural sites and objects from the regional geoheritage database and converted to a definitive list of potential sites of cultural landscape diversity. These objects are usually without relevance of scientific value. Parameters from the additional criteria set of the local geodiversity sites (Scottish geoconservation methodology) were found useful to select geocultural object from the preinventory with the cultural and community significance emphasizing educational and touristic interests. The selection set were classified into thematic categories. The major groups are mining - industrial heritage and settlement – land use related objects. The mining and industrial heritage includes mining and glass – porcelain industry buildings which are concentrated around three major medieval mining areas. The settlement – land use heritage includes carved cellars (16 settlements), built water systems and special land use types (e.g. agricultural terraces). After the selection and qualitative assessment procedure 40 potential geocultural site were identified. As a conclusion this inventory is a preliminary work and essential for understanding the regional cultural landscape heritage but also suitable for defining spatial planning policies and geoconservation strategies.

GEOHERITAGE'S TOTEMIC ASPECTS

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Day: Tuesday

Session Number: 3

Time: 14:50

ABSTRACT:

The Totem is a natural element, loaded with symbolic content that functions as an aspect of a social group's identity; this symbolic content is the product of the meanings that are built thanks to the relationship of society with the element. Geoheritage is made up of those elements that give it its high scientific and cultural value to the region, which respond to the multiple meanings that society ascribes to its environment; because of the interest it arouses in scientific, aesthetic, spiritual, historical, among other terms, these elements acquire a symbolic load that makes them stand out among nature.

Thus, some elements of the Geoheritage acquire immeasurable meanings, by which these features or elements are written in the normative and discursive identity of one society; for example, to outline this aspect, it is possible to observe motifs of geological heritage in a variety of shields of multiple political-administrative entities in Latin America: volcanoes, rivers, mountain ranges and other elements of continental geodiversity are represented as territorial pride. Therefore, societies are represented by these elements, they act as cohesive aspects, they represent the values and characteristics of those who inhabit the territory where they are located.

Given this construction of meaning, it is possible to understand the element of Geoheritage as Totem: it stands out from nature, configures the identity of a population given its symbolic value, it is incorporated as an indispensable aspect of the history of the territory and its protection is not something debatable. Safeguarding the element is safeguarding the very essence of the social group that signifies it, an indispensable element for the territorial cohesion. Thus, for certain elements of the Geological Heritage that are considered as identity, their geoconservation supposes a moral, ethical and political responsibility; it is not only an aspect of nature, it is an element that, from a relational conception, represents the values and characteristics of a social group. Taking care of it is taking care of the group.

ESSENTIAL GEODIVERSITY VARIABLES

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Day: Tuesday

Session Number: 4

Time: 15:20

ABSTRACT:

Geodiversity is of global importance. However, very limited international efforts have been devoted to developing measures that support decision making for supranational and global policy targets and sustainable development goals (SDGs). This is at a time when rapid environmental change is driving the need for complex and comprehensive scientific information that supports policies aimed at managing natural resources through international treaties, platforms, and networks. Therefore, we present Essential Geodiversity Variables (EGVs).

This follows successful approaches in other fields, where science- and policy-relevant information has been gathered through Essential Variable frameworks for climate, oceans, biodiversity, and SDGs (ECVs, EOVs, EBVs, and ESDGVs, respectively). These efforts have improved consensus on terminology and identified essential sets of measurements for characterising and monitoring changes on our planet. In doing so, they have advanced science and informed policy. As an important but largely unanticipated consequence, conceptualising these variables has also given rise to discussions regarding data discovery, data access, and governance of research infrastructures. Such discussions are vital to ensure effective storage, distribution, and use of data among management agencies, researchers, and policymakers.

Essential Geodiversity Variables represent a missing piece in the Essential Variables framework. In developing EGVs, we advocate a holistic approach that recognises and tracks the integrity of the abiotic and biotic components of geosystems and ecosystems. This is the most effective means by which to address global environmental challenges.

DILEMMA OF GEOCONSERVATION OF MONOGENETIC VOLCANIC SITES UNDER FAST URBANISATION AND INFRASTRUCTURE DEVELOPMENTS

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Day: Thursday

Session Number: 8

Time: 15:05

ABSTRACT:

For centuries societies have utilised volcanoes for resources, causing modification of the landscape. Recently, abandoned quarry sites have become significant geosites, where the magmatic plumbing system of a monogenetic volcano may be exposed, easily accessible, and ready to be visited and utilized as a geosite for volcanology and hazard education. The UNESCO IGCP Project [# 692. Geoheritage for Geohazard Resilience] promotes sites allowing volcanic processes to be engaged with and visualised by laypeople and scientists alike. Auckland city, the largest in New Zealand, is built on an active monogenetic volcanic field. Fourteen scoria cones within the Auckland City metropolitan boundaries are managed by the T?puna Maunga o T?maki Makaurau Authority. This is a co-management framework between Auckland Council and indigenous groups with cultural ties to the scoria cones. While we acknowledge cultural and historical importance of these sites as significant population centres prior to European settlement, potential of these sites for engagement in a geological context is not made explicit. In comparison to other sites in wider Auckland, outcrops are limited. The level of protection for cultural and archaeological sites through the Maunga Authority, in addition to aspirations for these sites to be designated as a World Heritage site, means this is unlikely to change, and we do not argue otherwise. In south Auckland, rapid urbanisation and industrialisation since the mid-20th Century has seen no protection afforded to sites as culturally significant and once as spectacular as those within Auckland City. Demand for extractable scoria has led to physical degradation of cones, and in some cases destruction. Lack of meaningful geoconservation policies sees this continue into the present. Outcrops exposed by quarrying, showing the internal structure of a scoria cone, are located at an industrial park in Wiri, South Auckland. We document threats facing these geosites monitored through several visits over five years. In Hungary, though the Bakony-Balaton UNESCO Global Geopark manages some abandoned quarries, locations

outside of the geopark are not afforded the same. We highlight this at a 100-year-old abandoned basalt quarry that may be brought back into production, placing pressure on local communities who value its geoheritage. These two sites demonstrate the need to develop ethical guidance on geoconservation of significant sites in an industrial and urban context.

BUILDING A CASE FOR THE CONSERVATION OF QUATERNARY GEOHERITAGE SITES IN THE UAE

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Day: Wednesday

Session Number: 6

Time: 16:00

ABSTRACT:

Quaternary paleoenvironmental archives are essential for our understanding of past climate change and humanity's response to the resultant alteration of resources. In the age of anthropogenic climate change, these sites are not only important scientifically, but also educationally to teach people the impact of climate change, as well as the role it played in shaping past communities. The Middle Eastern landscape is highly reactive to even subtle changes in the environment and climate change has been instrumental in driving major demographic variability of this region throughout antiquity. As such, palaeoenvironmental archives in countries such as the UAE are crucial for our understanding of the role of climate in the dispersal of early human populations out of Africa. The importance of archaeological sites in the UAE is increasingly recognised, with many sites benefitting from extensive research and conservation. Similarly, the rich geological history of the country is afforded a range of protective measures and has widely been integrated into national tourism strategies.

Despite the recent growth of geoheritage conservation in the UAE, the protection of non-geological Quaternary geoheritage sites has been entirely disregarded. While geological heritage sites often comprise large, impressive formations such as uplifted and folded mountainous features, Quaternary landforms comprise much smaller, less obvious features such as dunes, gravel ridges and palaeolake deposits, which are frequently unconsolidated and easily erodible. With the lack of a protection framework and the ongoing rapid economic development of the country, many of these archives have been destroyed or are under imminent threat. At present, no assessment has been conducted to examine the possible extent of such loss. A system must be established for scientists to record and highlight the potential threat of destruction of these irreplaceable archives.

For the first time, this study is compiling a database of Quaternary/palaeoenvironmental/archives in the UAE. A total of 117 locations from studies between 1988 and 2015 are being assessed for their risk status as well as scientific and educational value. Preliminary results have found that 11 sites are in poor conditions and 15 are already destroyed and unrecoverable. The rest of the sites are being considered for potential risk from factors such as urban development, expansion of agriculture, and sea level rise.

GEOHERITAGE BASED GEOTOURISM IN TRANS-HIMALAYAN DISTRICT OF LAHAUL AND SPITI DISTRICT, HIMACHAL PRADESH, INDIA

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Day: Monday

Session Number: 2

Time: 16:40

ABSTRACT:

Geoheritage are those components of geodiversity that are specifically identified as having conservation significance, i.e. that have some specific value to human society and therefore ought to be conserved, particularly if they are threatened by human activities and could therefore be lost or damaged. The Lahaul and Spiti district of Himachal Pradesh, India is unique due to the presence of Tethyan sediments that are exposed and have abundance of fossils that makes it a rich and valuable geoheritage site. Geotourism based on the geoheritage sites render geographical sense of place and is of paramount significance in the study area. The research focuses upon the study of various existing tourist hot spots and potential geoheritage sites. The main objective of the study is to assess the human response (geotourism) to the diversity of existing and potential geoheritage sites in the area. The study is largely based on the field work conducted in the study area between 20014-19 in which data has been collected through structured questionnaire survey, observation and in-depth interviews and SWOT analysis has been done accordingly. The locations of geoheritage sites have been marked using Global positioning System (GPS) and an overlay map has been prepared using Arc Map 10 (GIS software). Overall, the major issue is the lack of geoconservation policy and inaccessibility which needs to be addressed with better management efforts such as fossil park or geo-park establishment.

OUTSTANDING GEOHERITAGE VALUES OF MT. SEORAKSAN

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Day: Thursday

Session Number: 8

Time: 14:45

ABSTRACT:

Mt. Seoraksan displays an almost complete mountain geomorphic system of considerable contemporary dynamics, with outstanding scenery and spectacular landforms. The mountain is characterized by an area of outstanding geodiversity including rock-controlled landforms, diverse granite landforms, inherited cold-climate landforms and highly active contemporary geomorphological processes. Proterozoic granite and metamorphic rocks display quite distinctive landform evolution history compared to Jurassic and Cretaceous granites. While no clear glacial landforms exist in Seoraksan, widespread blockfields, blockslopes, and blockstreams provide significant evidence for peri-glacial climate from the last glacial period. Slope steepness and extreme rainfall events are the decisive factors to explain frequent mass movements under seasonally extreme East Asian Monsoon climate system which leave visible erosional and depositional evidence on slopes and in valley floors. These on-going geological processes in the development of landforms as well as outstanding geomorphic features of Mt. Seoraksan are worth being considered to be nominated as a UNESCO World Heritage Site.

PROMOTION GEOHERITAGE THROUGH FIELD BASED GEOEDUCATION EVENTS, A CASE STUDY OF HUNGARIAN GEOSITE DAY, BÜKK REGION ASPIRING GEOPARK

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Day: Friday

Session Number: 10

Time: 14:25

ABSTRACT:

Geohiking is short term for geology-themed hiking, where field based activities intended to expose geodiversity for the public. These activities are becoming more important worldwide and the role of special thematic trails with features of geological interest. (e.g German Volcano Route) has supporting role in the public dissemination. The integrated network of protected geosites in nature conservation areas established special nature trails in Hungary from 1990 years, These played a major role in the organization of field based geoeducation activities, The Hungarian Geosite (Geotope) Day established in study area (2008, Cserépfalu, Bükk Region Geopark) where spectacular geological and geomorphological objects included in Devil's Tower nature trail. Today, the event is nationwide and has a history of more than a decade and the number of locations exceeds 20.

Our study was conducted at the event establishing site (Cserépfalu, Bükk) which provides guided geohiking experiences and field educational games. A questionnaire survey is a widely applied method to examine visitors' perceptions, characteristics, motivations and attitudes about development priorities. The survey was conducted over several years includes questions about the event organization, characteristics of the geosites and the for several years with more than 1,000 people participating The goal of our research is to find out how knowledge and visitor experiences on geosites can be changed through the field activities. We present the main characteristics of Geotop's Day, the geosite network of study area and the evaluated results of the questionnaires.

DEGRADATION RISK ASSESSMENT: UNDERSTANDING THE IMPACTS OF CLIMATE CHANGE ON GEOHERITAGE

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Day: Monday

Session Number: 1

Time: 14:55

ABSTRACT:

The risk of degradation is a criterion that should be implemented as a first stage of any geoheritage inventory, especially to tackle the effects of climate change already in act.

The present research proposes a degradation risk assessment of geosites that considers the extrinsic factors, both natural both anthropogenic, that can damage the geological heritage or destroy it. The methodology had been applied to the Maltese Archipelago, central Mediterranean Sea, where considerable researches have been undertaken by scientists in order to showcase the international geological and geomorphological significance of Maltese landscapes. Considering the definitions proposed by García-Ortiz et al. 2014, we considered three criteria to assess the degradation risk: natural vulnerability, anthropic vulnerability and public use. Respectively, these criteria are described as: the possibility to a geosite to be damaged or destroyed by natural processes that are not involved in the creation of the site; the geological value of the site and considers the damages that can be made for economic interest or private interest; all the anthropic threats that can affect the geosites, not related to its geological value, but more connected with negligence actions, lack of knowledge and legal protection. For each criterion have been considered several parameters in order to have a detailed numerical evaluation. The results in the study area show how the degradation risk of the geosites is in most of the cases related to negligence and lack of knowledge of the geological heritage that leads at incorrect public use of the geosites areas. In fact, most of these areas are used by locals and tourists for recreational activities that may degrade the site.

The anthropogenic vulnerability is almost non-existent; the natural vulnerability is relevant for the sites in proximity to the coast. Coastal areas are complex environments more exposed to natural hazards and worst affected by effect of climate change (sea level rising, changes in coastal deposition and erosion, increase of violent marine storms and tsunamis from near-?eld and far-?eld sources). Moreover, the pressure of tourism and infrastructures are concentrated in these areas. To conclude, the degradation risk assessment gives an overview of the condition of the geosites and provides precious information for a correct protection of the geological heritage and its management, with attention to the effects of climate change.

"THE CITY ON THE BORDER": DEVELOPING URBAN GEOTOURISM IN BRNO (CZECH REPUBLIC)

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Day: Thursday

Session Number: 9

Time: 16:50

ABSTRACT:

Brno city lies on the contact of two large geological units – Bohemian Massif and Carpathian Foredeep. This implies high lithological and morphological diversity. Together with a long-lasting history of human influence on the area, the city possesses a high diversity of geotourist resources. Based on the literature review and fieldwork, the sites with geotourist potential were identified: 1) protected geosites and sites included in the national database of geological localities, 2) other natural sites (not included in the previous point), especially small outcrops or hydrological features, 3) geocultural sites and objects (e.g. anthropogenic landforms, archaeological sites with strong link to geodiversity, buildings where the local material is used).

In Brno city centre, all groups are represented. In cooperation with Tourist Information Centre, Brno centre geotrail was designed. The philosophy of the trail is to point out the fact that geodiversity is everywhere, even in the places where the visitor does not expect it. Other activities linked to urban geotourism development and partly geoconservation are represented by guided walks, monitoring of protected sites within the city and identifying the new ones and updating care plans of two National Natural Monuments situated within the city. Last but not least, so-called rescue geological and geomorphological research is made at sites, which are going to disappear due to the urban development.

The abovementioned activities are associated and supported by the project “Geodiversity within urban areas: perception, function, potential” funded by Technology Agency of the Czech Republic (project code: TL02000219). It is a complex project where the research institutions and local stakeholders are involved with an aim to create a “Geodiversity partnership”, a network which is going to focus on the promotion of geodiversity, geoconservation and sustainable geotourist activities within the Brno City.

"SASSI", THE RUPESTRIAN OLD TOWN OF MATERA, WHERE EACH HISTORICAL TOUR COULD BECOME AN IMMERSIVE GEOTOURISTIC ITINERARY (BASILICATA - SOUTHERN ITALY)

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Day: Thursday

Session Number: 7

Time: 14:25

ABSTRACT:

The "Sassi", the Italian word for stones, is the name of the surprising rupestrian old town of Matera in Basilicata (southern Italy), characterized by the excavation of a complex network of caves, tunnels, cisterns, houses, and churches, dug in carbonate soft-rocks. This stunning rupestrian scenery, whose first human settlement dates back to the Palaeolithic, has been included in the UNESCO World Heritage List since 1993, and was designated as the European Capital of Culture 2019. Due to its features, Matera has been the location for several movies, including the "Bond 25 - No time to die". As a consequence, Matera is attracting a large number of tourists fascinated not only by the cultural patrimony of the old town, but also by its rural setting.

The "Sassi" (the old town of Matera), the "Gravina di Matera" (the canyon along which the "Sassi" developed), the "Murgia Materana" (the almost barren karstic plateau incised by the canyon), and the clayey hills on which the modern districts spread, represent a unique opportunity for an urban geotour while walking from the main square of the town down to the bottom of the "Gravina di Matera". An example of just how fascinating, and feasible, this tour could be is to trace the course of water from the clay hills of the new town. Here remnants of ancient gravelly-sandy flat deposits host an aquifer that originally fed springs located above the old urbanized side of the "Gravina di Matera". These springs, now completely buried below the buildings of the new town and almost forgotten by the local inhabitants, fed the old town where water was stored in small (domestic) or very big (public) cisterns. The latter have now become an underground touristic attraction in themselves (i.e. the "palombaro lungo", located under the main square of Matera).

In conclusion, some selected stops along historical paths within "Sassi" could offer the opportunity to admire the amazing geology of the area, and to learn about the geological reasons for the particular urbanization of the old town of Matera.

LAND PLANNING AS A TOOL FOR EFFECTIVE PROTECTION AND MANAGEMENT OF GEOHERITAGE. CASE STUDY: BASQUE COUNTRY.

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Day: Thursday

Session Number: 8

Time: 15:45

ABSTRACT:

The Basque Country, an autonomous region of 7,234 km² and 2.2 million inhabitants located southeast of the Bay of Biscay, offers an innovative approach for protection of its geoheritage through land planning regulation.

The Land Planning Act 4/1990 of 31 May regulates and defines the land management instruments: Land Management Guidelines (LMGs), Partial Territorial Plans (PTPs) and Sectoral Territorial Plans (STPs). LMGs are generally binding for all land managers. PTPs develop the LMGs and establish the management criteria for each of the 15 Functional Areas into which the territory is divided. STPs regulate sectoral interests. These instruments have a cascading hierarchy: LMGs prevail over PTPs and STPs.

Decree 128/2019, of 30 July enhances LMGs for the non-urban environment. It zones the territory into homogeneous spaces, each defined according to their inherent best use, and sorts them into six land categories among which is Special Protection. On top of these, overlapping conditions such as natural risk and climate change, and green infrastructure, further restrict the uses established for each zone based on special interest. Land uses are also listed. Finally, a matrix crossing land categories with uses determines the final code for regulation of each zone: encouraged, permitted or prohibited use.

Special Protection category applies to all valuable ecological, cultural or landscape elements, and the declared 150 Basque geosites are specifically included, among other heritage. The general criterion for these areas is to limit anthropic intervention, and if the area hosts any land use, to ensure its sustainability. For these areas, only conservation and environmental restoration activities are promoted actively. Extensive recreation, livestock, forest use and certain infrastructures are also considered admissible, but are subject to development planning. Activities incompatible with the general criterion, and all buildings except those of

public or social interest are considered prohibited. In addition, the LMGs establish the importance of geosites as a tourist resource that STPs must take into account.

This communication expresses, using the example of the Basque Country, the effectiveness of the territorial planning approach for the adequate protection of geoheritage. Its consideration as Special Protection land category by the territorial rule of the highest rank (LMGs) is key for the success of this approach in any other region of the Earth.

GEOPARQUEMET: DIGITAL TOOLS TO HIGHLIGHTING GEODIVERSITY IN URBAN PARKS. CASE STUDY IN SANTIAGO METROPOLITAN PARK, CHILE.

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Day: Friday

Session Number: 12

Time: 16:35

ABSTRACT:

Santiago Metropolitan Park, established in 1917, is the biggest urban park in Latin-American and the fourth in size around the world. With 737 hectares it's the most relevant green belt in the city. The park is placed in a hill chain that is an extension of Andes Mountain that faces the Santiago city and it includes 6 summits between 1,365 and 1,773 m a.s.l. During XVIII and XIX centuries, the quarries located in the park provided the stones for many relevant urbanistic improvements. Moreover, their rocks were used for the first park constructions as Victoria Turret, Tudor Hall and the Funicular (1925), the zoo, opened in 1931, and Antilén and Tupahue swimming pools between 1960 y 1970, the last one built within a quarry hole. Volcanic and intrusive rocks are present in PARQUEMET. Volcanic rocks, from dacitic to rhyolitic composition, belong to Abanico Formation with Upper Eocene to Early Miocene ages (28.3 ± 0.7 Ma to 22.3 ± 1.8 Ma). The intrusive bodies, with andesitic to dacitic composition, are genetically and temporal related with volcanic rocks. Due to high grade of alteration and metamorphism, these rocks have not been directly radiometrically dated. However, similar types of rocks, closely located to the park, gave ages between 22.3 ± 1.8 Ma to 20.6 ± 0.2 Ma. All these rocks represent the products of subaerial volcanic eruptions, explosive at Eocene ages and effusive at Miocene ages. The intrusive bodies would represent the feeder pipes of volcanic subaerial activity. During Neogene these rocks were deformed and faulted (mainly high angle), as well as affected by alteration and metamorphism that changed their texture

and mineralogy. A great number of geosites has been selected in order to show the most representative and singular geodiversity features. They have been grouped into different georoutes to go down the park trails or virtually online. Nowadays, more than ever, due to current sanitary crisis and quarantine, the use of digital tools allows to bring the geodiversity values to the population who are unable, at this moment, to physically visit the park. Therefore, a project's webpage has been designed and hosted at the Geological and Mining National Survey of Chile main webpage to show interpreted 2D and 360° photographs and 3D models, as well as explaining videos and an interactive geological map. All of that to bring to the people, in a virtual way, the park's geodiversity and a piece of the natural and geological history of Santiago city.

WE HAVE A DREAM: MURGE, THE LOST CONTINENT IN SOUTHERN ITALY, AS A GEOPARK!

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Day: Friday

Session Number: 12

Time: 16:55

ABSTRACT:

Murge (Apulia, Southern Italy) is part of Adria, the plate “squeezed” between Africa and Eurasia from when these two continents began to converge. Deformed Adria rocks are widely distributed in the orogens surrounding the Mediterranean Sea, and in many newspaper and magazine articles as well as online videos, Adria is described as "a lost continent". Even if this definition is "scientifically incorrect", the idea of the lost continent is very attractive, also because in Italy there is a region where a small part of this lost continent still survives. This region corresponds to the Apulia Foreland where Murge represents the central area. Here, structural, sedimentary, geophysical, magnetostratigraphic, geochemical attributes of the only Adria crustal rocks that are rooted on the mantle in their original position can be studied. Within plate tectonics, Murge can be considered as the first piece of a puzzle whose location in the original painting (the Adria Plate) is known.

Based on this premise, the "Alta Murgia" National Park and the "Dipartimento di Scienze della Terra e Geoambientali" (Earth and Geoenvironmental Sciences Department) of Bari "Aldo Moro" University decided to join forces to propose Murge as a Geopark.

Following the leitmotiv of Adria, the "Murge Geopark" working team will suggest a geological "journey" connecting different geosites and the history of Murge in a storytelling that starting from the origin of the Adria Plate, passes through dinosaurs tracks, a Neanderthal skeleton almost entirely covered by speleothem deposits, the peculiar drainage network in a karst area and many other features, and arrives at the spectacular use of local rocks in the building of white cathedrals, castles and old towns.

GEODIVE PROJECT: RECOGNITION, MAPPING, ASSESSMENT AND ENHANCEMENT OF GEODIVERSITY, “FROM ROCKS TO STONES, FROM LANDFORMS TO LANDSCAPES”

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Day: Tuesday

Session Number: 4

Time: 15:40

ABSTRACT:

As Earth scientists we are called to respond to the UN and UNESCO demand for raising and spreading awareness on Geodiversity. Nevertheless, lack of EU and national conservation policies including the non-living elements of natural heritage makes it hard to encourage public respect for important geological features.

The Piemonte Region (NW Italy) showcases an incredible variety of geological and geomorphologic elements, which represent a natural heritage as well as a physical and touristic resource, even if endangered by natural hazards. To fulfil the UN 2030 Sustainable Development Goals, the general aim of our project is to set up and test a comprehensive methodology for promoting knowledge on geodiversity, enhancing protection and best management practices of geoheritage at a local and regional scale: “from rocks to stones, from landforms to landscapes”. Due to its inter- and multi-disciplinary tasks, this research involves a diversity of academic disciplines and professional specializations.

For these purposes, our first specific objective is an enhanced legibility of the information on regional geodiversity produced by Earth scientists through Data Infrastructures. Consistent and formal geologic knowledge on lithological units and landforms of the Piemonte Region has been elaborated for further effective geodiversity action plans.

By using encoded knowledge, the second research step is the development of a holistic “geosystem service approach” (Gray, 2004) for mapping and assessment of geodiversity and related services provided to society.

As a third step, our research team created targeted solutions for promoting geodiversity and managing geoheritage within selected geoparks and geosites. Particularly, we disclosed the cultural heritage value of ornamental stones in promoting the geodiversity awareness.

General aim of the project requires a fourth final step: to spread knowledge on cultural geoheritage. This has been achieved thanks to the cooperation with local governments, parks and schools. By giving training on acknowledgement and conservation of cultural landscape to environmental managers and teachers we started an adaptive learning process on geodiversity values, rather than imposing a fixed set of rules on geoheritage management.

UNESCO IGCP PROJECT 692. GEOHERITAGE FOR GEOHAZARD RESILIENCE: A GLOBAL GEOHERITAGE INITIATIVE TO SHARE KNOWLEDGE, RAISE AWARENESS AND COMMUNICATE ABOUT NATURAL HAZARDS

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Day: Monday

Session Number: 2

Time: 16:00

ABSTRACT:

Geoheritage is a concept that was created with the aim to preserve sites that expose the most valuable geological elements (geosites), in a similar way as biosphere reserves are used to protect biodiversity. It has become clear that the interest of geosites extends beyond pure conservation. The successful development of geoparks across the world has shown that a geo-oriented management of a territory has multiple and long-term benefits for the local

population that are in line with the UN Sustainable Development Goals. A particular aspect is that many geosites have the potential to raise awareness about natural hazards, hence increasing the preparedness and resilience of the communities, and decreasing the risk of disaster. Such action is particularly beneficial and needed in regions with high risk, such as large cities built in tectonically active areas. Geoheritage for Geohazard Resilience is the first UNESCO International Geosciences Programme project in geoheritage. The project aims to identify and develop those areas that have the best potential for development as 'geosites for resilience' in different countries around the world. It supports initiatives led by local scientists and fosters communication and collaborative works between the participants. One year on from its inception, projects are sprouting in Europe (Clermont-Ferrand, France), North America (Mexico City, Mexico), South and Central America (Arequipa, Peru; Cotopaxi, Equateur; Ometepe, Nicaragua; Nevado del Ruiz, Colombia), Asia (Taal, Philippines), Oceania (Auckland, New Zealand) and Africa (Dallol). Exchanges between participants have underlined the common difficulties that face scientists everywhere in transmitting knowledge and informing about risks in hazardous areas, and the need to develop interactive activities. Participants also share similar experience about the destruction of urban geosites with high scientific, touristic and educational value. Some of these results will be presented here and in other talks in this congress. To know more, contact us and visit www.geopoderes.com.

GEOHERITAGE OF A BRAZILIAN SEMIARID ENVIRONMENT: THE SERIDÓ ASPIRING UNESCO GEOPARK

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Day: Friday

Session Number: 11

Time: 14:45

ABSTRACT:

Seridó Geopark, the aspiring UNESCO Geopark territory name, is named after a native Brazilian word, of tapuia tradition - *ceri-toh* - which means “little or no foliage; little shade”, something that defines well the landscape from Northeastern Brazil region, of semiarid climate and little foliage vegetation, typical of the Caatinga Biome, which is only found in Brazil. It’s a territory with an area of 2,802 km², divided into six municipalities: Acari, Carnaúba dos Dantas, Cerro Corá, Currais Novos, Lagoa Nova and Parelhas. The local geology comprises eight lithological groups can be distinguished from the geological heritage area, dating from the Paleoproterozoic to Recent. The basement consists of high-grade metamorphic rocks, covered by Neoproterozoic supracrustal rocks. Extrusive and intrusive Ediacaran, Cambrian, Early Cretaceous, and Paleogene magmatisms also occur in the area. Neogene conglomerates and sandstones complete the geologic register, besides the Quaternary sedimentary cover. The inventory of sites with relevant geological interest in the Seridó Aspiring Geopark area comprise 21 geosites with different types of interests, such as mineralogical, petrological, hydrological, geomorphological, paleontological, volcanic, among others, of regional to international value, that sites represent the territory’s main geological units. They are integrated with the communities of the region through culture, economy, tourism and science. Many are recognized by population as a heritage of Seridó. Of the 21, we can highlight four geosites with international significance, according to the applied evaluation methodology: Vale Vulcânico, Mina Brejuí, Cânions dos Apertados, and Açude Boqueirão. The first one is an area with basaltic columnar disjunctions with variation of dips, associated with 25 Ma volcanism; the second one is the main scheelite mine in South America, whose exploitation started in the 1940s was responsible for the economic growth of the Seridó region; Apertados is a canyon whose quartzite walls were shaped by the Picuí river action, a place of unique beauty, considered one of the State’s seven wonders; finally, Boqueirão is a geosite around on the region’s main dams, with occurrences of

metaconglomerates, quartzites and pegmatites. This paper aims to present the geological heritage of this territory, which since the end of 2019 is an Aspiring UNESCO Global Geopark, and emphasize its relationship with local communities.

BAHLUIE? VALLEY AT COSTE?TI VILLAGE GEOHERITAGE SITE (MOLDAVIAN PLATEAU, NORTH- EASTERN ROMANIA): THE NEED FOR PROTECTING, PROMOTING AND MANAGING A QUATERNARY GEOARCHAEOLOGICAL SITE

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Day: Thursday

Session Number: 9

Time: 16:35

ABSTRACT:

The Bahlui? Valley at Coste?ti village geosite has been recently studied and proposed as a geoheritage site. Previously this area was investigated due to the presence of the Coste?ti-Cier archaeological site which is currently integrated in the National Archaeological Repertoire. In this archaeological site different levels of Bronze Age populations have been studied as well as an earth wall from La Tene (8th?10th/11th century), and a 15th?17th century necropolis. In the area of the present day Coste?ti village, Bahlui? River leaves the Suceava Plateau area (with altitudes of 350?550 m a.s.l.) and enters the Jijia Hills (with altitudes of 50 to 200 m a.s.l.). The valley, which is incised 100 m in depth below the plateau level, suddenly becomes broader because of two massive Late Pleistocene landslides. These two landslides covered the former Bahlui? floodplain and have been incised by the Bahlui? river which created several meanders. One of these meanders was cut off creating an island. In the present day topography, the island represents a mound detached from the former floodplain level. The ancient populations used the area as a settlement site. The deposits in which the island is cut is multi-layered, consisting of landslide and fluvial deposits, paleosoils and archaeological remains. These layered deposits have the potential to show the Late Pleistocene and Holocene evolution of the contact area between the Suceava Plateau and Jijia Hills and the island becomes one of the most representative Quaternary sites of the Moldavian Plateau. Today the river is eroding the mound and protection measures are needed in order to limit the natural destruction of these important deposits and morphology. At the same time a management plan is needed for promoting the site at local, regional and national level. Further scientific investigations are necessary and can increase the value of the site.

TIME TRAVELLER IN ROKUA UNESCO GLOBAL GEOPARK – INTERPRETING GEOHERITAGE WITH VIRTUAL REALITY TECHNIQUES

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Day: Monday

Session Number: 2

Time: 16:20

ABSTRACT:

Rokua UNESCO Global Geopark (UGGp) in Finland celebrates the heritage of the last Ice Age. The traces of continental ice sheet and melt water streams are exceptionally well visible, and many of the formations reach superlatives in Finland. The quaternary landforms reflect properties of local bedrock that ranges from Archean to Proterozoic times. The unique geology creates habitats for several rare species and affects in many ways to the human history and cultural appearances in the area.

The ancient landscapes with mountains and volcanoes, impressive present geomorphology and its reflections in the area's living nature and culture are very fascinating topics for locals and visitors. However, a typical challenge interpreting the area's geoheritage is scale: geological time is very hard to realize and the magnificent environmental changes through the history difficult to imagine.

To enhance the interpretation Rokua UGGp came up with opportunities of virtual reality. An important inspiration was a virtual reality application launched in Odsherred UGGp in 2015. In 2017, Rokua UGGp launched a 3D mobile map application to introduce the area's characteristics. Collaboration with Kajaani University of Applied Sciences led to an innovation to combine virtual reality and the mobile map application to illustrate the historical landscapes and the geological time line of Rokua UGGp. Finally, a common EU-funded "Time Traveller" project was started in 2018, continuing until June 2021.

In the project, virtual time windows will be created in three geosites with assistance by scientific and pedagogical stakeholders. The time windows demonstrate past landscapes with geological processes, climate conditions and vegetation. They take the traveller i.e. onto the ancient mountains, rift valleys and continental ice sheet or into the earliest human dwellings. The time traveller can also explore the evolution of Holocene landscape like development of

eskers and dunes or the history of River Oulujoki from a Precambrian graben to a stone age village and sceneries before hydroelectric dams.

The virtual models will be part of new Geopark exhibitions in the area. In addition, views from the ancient landscapes will be captured in 360°-Youtube videos and the links to the videos will be added in the map application to enable mobile use wherever the traveller is. The virtual models with supporting materials benefit educational and geotourism actions in the region in future.

THE CONCEPT OF GEOCONSERVATION AND GEOTOURISM IN THE LIMPOPO PROVINCE, TO ENHANCE SUSTAINABLE DEVELOPMENT AND THE NATIONAL DEVELOPMENT PLAN OF SOUTH AFRICA

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Day: Wednesday

Session Number: 6

Time: 16:40

ABSTRACT:

South Africa has a rich geological history which spans some 4 billion years with the oldest rocks found on and around the Kaapvaal Craton. This includes ancient basins such as the Witwatersrand and Pongola Basins, meteorite impact of the Vredefort dome to the intrusion of one of the largest and most prolific igneous complexes in the world (Bushveld Complex). The geology also includes more recent Mesozoic Karoo Basins and the Drakensberg volcanics. In addition, mineral commodities such as platinum group metals (PGM), gold and coal drive the economy of South Africa. Yet very few geological sites are conserved and known to the public. It is important to acknowledge that geoconservation is a relatively new field in South Africa as a whole as well as in the Province. Many geological sites that can be of interest in a geosites or geopark context are not conserved, and this case study aims to identify such potential geosites. The sites should have significant geological history and/or cultural importance, while enabling the requisite economic development that the country needs. The Limpopo Province provides a wide range of rock formations from early Archaean crustal rocks (~3 billion years old) to the present Quaternary deposits. The Province remains one of the less developed and poorer provinces in South Africa, and therefore the outcome of this case study hopes to promote sustainable employment through geotourism by suggesting opportunities for communities around identified specific geological sites and potential geoparks. In addition to preserving identified potential geosites and areas, the approach will create a whole new way of viewing tourism and natural resource development in the Province that will combine the pleasure and economic benefits of tourism with the conservation of our distinctive places. It will foster a broader appreciation and national pride for our unique geological history. The geotourism in the Province will also contribute to alleviating poverty by involving local communities in the targeted potential geosites areas where community members can be trained as geotourist guides. Hence geotourism builds upon sustainability

and conservation efforts of the past, yet offers potential for more widespread employment while at the same time adding value to the underdeveloped scenic landscape in the Province.

A TALE OF TAAL CHURCHES: THE TAAL CHURCH RUINS AND THE NEW TAAL BASILICA AS GEOEDUCATION SITES TO HIGHLIGHT GEOHAZARD RISK IN AN AREA OF ACTIVE VOLCANISM AND TECTONICS.

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Day: Friday

Session Number: 12

Time: 16:40

ABSTRACT:

Just south of Metro Manila is the Macolod Corridor, a region of active volcanism and tectonics in the Calabarzon Region of the Philippines. The Macolod Corridor spans the length of south-central Luzon Island, bounded to the west and east by active volcanoes Taal and Banahaw, respectively. Within this region are multiple volcanic features like maars, scoria cones, and stratovolcanoes. Splays of the active Valley-Fault System and the Infanta Fault also cross this region. This volcano-tectonic setting poses geohazard risks to the millions of people living in the Calabarzon Region, however, it also provides opportunity for the communities to develop resilience to geohazards. One way of building this resilience is by locating sites that can be used for tourism and education to highlight geohazards awareness. In this study, we focus on two heritage sites: the old Taal Church ruins and the new Taal Basilica as examples of present tourism sites with potential for geoeducation.

Originally built with coralline limestones near the shores of Taal Caldera Lake in the town of San Nicolas, the old Taal Church was buried by the calamitous 1754 eruption. It was relocated and re-built with ignimbrite blocks in 1755 at the present day heritage town of Taal, farther from Taal Lake. The new Taal Basilica was destroyed in 1849 by an earthquake, rebuilt again, and inaugurated in 1865. Through the subsequent years, the Taal Basilica has undergone a series of partial to total geohazard-related destruction and rebuilding. Today, the

Taal Basilica survives as the largest Catholic church in Asia and a tourist attraction for that reason.

In this study we assess the potential of the Taal Church ruins and the new Taal Basilica sites for geo-education. We propose the possibility of including the re-telling of the history of the two sites in tourism promotions and programs to emphasize the effects and risks of living in a region of active volcanism and tectonics.

GEPARKS, PATHWAYS FOR INTERNALIZATION OF DEVELOPMENT IN THE STATE OF BAHIA/BRAZIL

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Day: Friday

Session Number: 11

Time: 15:05

ABSTRACT:

The Geological survey of Brasil – CPRM listed 38 proposal for geoparks in Brazil. Araripe Geopark, launched in 2006, was the first geopark of the country and the first of the Americas. But, by the way, for at least 10 years, no other proposal reached its fully implementation in the country. The State of Bahia is located at the Northeast region and, with seven proposals listed by CPRM, is the Brazilian state with more proposals of potential geoparks of the country. The state has a population of almost 15 million of inhabitants, but around 25% of these inhabitants live in the Metropolitan Region of Salvador -RMS, the capital of the state, which also concentrates more than 40% of the state Gross Domestic Product - GDP. The geoparks proposals listed by CPRM for Bahia are all located at the countryside, more 200 km away from the RMS, and are mostly related to geomorphological aspects. Four of these proposals are located at the region of Chapada Diamantina, an ancient diamond mining region, that is marked by mountain ranges and plateaus, sculpted in Proterozoic low metamorphosed sedimentary rocks, with caves, waterfalls and relevant mining heritage. The Serra do Sincorá proposal, in particular, encompasses the municipalities of Andaraí, Palmeiras, Mucugê and Lençóis, receives annually a significant number of tourists from many parts of the world and represents one of the main nature touristic destinations of the country, concentrating governmental investments for the promotion of this activity in the state. Due to this, the proposal, that already counts with an inventory of 22 geosites and an association for its implementation, is the most advanced proposal in Bahia and can be a good opportunity for the state to experiment and learn about the process of geopark implementation, strengthening and optimizing the touristic investments. Considering the other proposals for the state, São Desidério, Morro do Chapéu and Alto Rio de Contas already counts with geological heritage inventories but lacks with officially constituted organizations focused in their implementation. All the efforts concentrated in the Serra do Sincorá proposals could be shared with the other proposals building a pathway for the interiorization of sustainable development in the state, helping to distribute its GDP, spreading scientific knowledge, reinforcing local identities, promoting the Sustainable Development Goals and fostering healthy lifestyles.

SOILS: PROTECTING THE MOST HIDDEN GEOHERITAGE

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Day: Tuesday

Session Number: 4

Time: 16:00

ABSTRACT:

The conservation of geodiversity has been discussed by geoscientists all over the world mainly in the last twenty years. Significant steps have been given to identify, map and protect the most important part of it: the geoheritage. Many countries published their geosites inventory that commonly reunite sites of geological, geomorphological and hydrological interesting features. However, soils have not been recognized and valued enough in spite of their great range, especially in some countries as Brazil. In the inventory carried on by the Brazilian Committee of Geological and Paleontological Sites there are no pedosites. This is probably due to the specific condition that soil occupies in the natural systems. Soils are not at or over the surface. They are generally under it and people usually not see them. It is easier to notice and recognize the eventual importance of a mountain, a volcano, a great waterfall, and even a fossil, when unrecovered, its relevance is generally recognized. Soils have multiple functions, as in human occupation, agriculture, pasture, biodiversity, water balance regulation and others. But they also tell us about the recent history of Earth and its changes. The soil assemblage, its attributes and features and position on the landform reflect formation and evolution processes of the Earth surface over the time. So, this work presents the initial criteria and justification to stablish the pedological heritage in Brazil in order to contribute to its divulgation, valuation and protection. The existence of a wide and robust Brazilian Soil Classification System reveals a large national pedodiversity. The challenge of identify which soil is a geoheritage is enormous. Some Brazilian soils have a strong meaning to the history and economy, but, as a pedoheritage, the scientific value is required and others aspects should be considered. Beside paleosols, the present study proposes that all the soil profiles from all the Brazilian Soil Classification and Correlation Meeting Books and the representative soil profiles from the Soil Data Base from Brazilian Institute of Geography and Statistics should be considered Brazilian pedoheritage. It is important to have in mind that some of them may have been destroyed, mainly by human activities. Therefore, it is mandatory that pedologists and soils institutes, universities and organizations gather efforts to identify possible risks and defend their protection.

GEOLOGICAL HERITAGE FOR GEOCONSERVATION AND GEOTOURISM PROPOSE IN THE CENTRAL MASSIF AREA (NORTHWESTERN PART OF MOROCCO): INVENTORY AND QUANTITATIVE ASSESSMENT

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Day: Monday

Session Number: 1

Time: 15:00

ABSTRACT:

Central Moroccan Massif is one of Variscan massifs, it belongs to the northwestern part of Moroccan Meseta. This area displays varied types outcrops that range from the Ediacaran to the Quaternary.

This richness pushes us to be aware about it, for this reason, an inventory and a quantitative assessment of geosites in the central massif area must be done. Selected geosites reflect the geological, geomorphological and paleogeographical history of the area and represent different types of geological heritage. 10 geosites were selected as a preliminary result of the inventory in order to represent different types of geological heritage: (1) Miocene / Trias unconformity of Maaziz, (2) Autunian fluviatil volcano-detritic Red serie, (3) Autunian Trachyandesite of Tiddas, (4) Variscan synorogenic Granite of Oulmes (5) Contact of Oulmes Granite and /Mid Cambrian /Lower Ordovician (giant) andalousite shales host

(cornéenne), (6) Upper Ordovician slump balls (7) Middle Devonian reefal limestone olistoliths within the Tournisian turbidites West of Tiliouine, (8) Famennian-tournaisian calcareous (Mid Devonian reef limestones) rocks falls of Tiliouine, (9) International reference Devonian serie of Ain Jemaa, (10) Quaternary Basaltic flow of El Harcha.

Most of those geosites are little known by the general public. The inventory, assessment and preservation deal to create a geoconservation strategy and geotourism policy basing on the significant scientific, educational and touristic values of selected geosites in order to improve the regional touristic development and engage people in this development and preservation.

Keywords: Central Massif area, geological heritage, geosites, inventory, assessment.

GEOCONSERVATION AND RURAL DEVELOPMENT: A MODEL PARTNERSHIP

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Day: Friday

Session Number: 10

Time: 14:05

ABSTRACT:

The development of a proposed new geopark in western Ireland is bringing national and regional authorities together to maximise financial and planning resources to strengthen the local economy by building on the area's internationally significant geology.

Joyce Country & Western Lakes geopark covers parts of Counties Galway and Mayo in western Ireland. Its relatively well-exposed rocks span 700 million years of geological history, from the opening of the Iapetus Ocean to Ireland's last glaciation. Three fresh water lakes separate the rolling pasture land underlain by Carboniferous limestone in the east from the rugged mountains and valleys of Neoproterozoic to Silurian metamorphic, igneous and sedimentary assemblages in the west.

The need for economic development of sustainable communities while preserving the natural beauty of western Ireland has long been a contentious topic. Ways to allow vibrant communities to flourish and traditional language, farming methods and culture to grow are the collective aim of communities, local authorities and national government bodies. A new project led by Geological Survey Ireland is working with local, regional and national partners to encourage local ownership and engagement in the development of a geopark for eventual UNESCO Global Geopark status. Project partners include Údáras na Gealtachta, the body responsible for economic development in areas where Irish is the primary language; the local government authorities of Galway and Mayo County Councils; Fáilte Ireland, the national authority for the promotion and development of Irish tourism; Coillte, the national forestry land management agency; and local community groups.

It is anticipated that by having all authorities involved in this well-financed project, the protection and promotion of the geological heritage will be given due regard in planning and future economic development and that this strategic partnership will mature into a deep, respectful and long-lasting co-operation for geoconservation and rural development.

POLLUTED CAVES, THE MOST ENDANGERED COMPONENT OF CROATIAN GEOHERITAGE

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Day: Tuesday

Session Number: 4

Time: 16:20

ABSTRACT:

Caves in Croatia are protected by Nature protection law and enjoy formal state protection. A part of the already investigated caves enjoy several main types of legal protection. Caves can be individually protected as Nature monuments (geological-geographical, paleontological, geomorphological, hydrological). They can be protected as parts of the bigger protected areas (National parks, Nature parks, Significant landscapes etc.), Geoparks or protected as Natura 2000 sites. The last major campaign of declaring caves as protected geosites took place in the late 1960s. In 21st century, Croatia protected only one cave as geoh heritage site. Besides few initiatives from scientists and professional geologists and geomorphologists organizations, Croatian nature protection system did not yet provide a system for geodiversity and geoh heritage management and protection based on clear criteria for inventory and evaluation, and there are no signs of its creation in the near future. In the case of caves as especially fragile environments, the lack of clear policies and proper management resulted in problems like pollution and degradation. Around 3400 caves have been registered in the formal Croatian cave cadastre, although the real number is estimated to be closer to 10000. Among these, there are more than 800 polluted caves across Croatia, as registered by the Clean underground project of the Zagreb Speleological Union. Despite the fact that all caves are protected by law and the fact that there is a cadastre of polluted caves, the authorities did not take any action, yet everything was left to the volunteer activities of the speleological community gathered around Clean Underground initiative. In this work, we address the spatial distribution of polluted caves, with the aim to elucidate the sites of highest pollution spatial density and determine areas in biggest need of protection. We also wish to uncover prominent social factors that enable or facilitate waste disposal into the karst underground.

Vast numbers of polluted sites can easily overwhelm local cave remediation capacities, so it is crucial to build a remediation priority list, a long-term strategy that will enable the rehabilitation known sites and prevent further pollution. We call for a methodical revalorisation of underground geoh heritage sites that should take into account key protection and management issues such as recognition and prevention of cave pollution.

PRINCIPLES OF GEOCONSERVATION IN PROTECTED AREAS: EXAMPLE OF THE ITATIAIA NATIONAL PARK, BRAZIL

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Day: Thursday

Session Number: 7

Time: 14:20

ABSTRACT:

Nature involves biodiversity and geodiversity. While the threats to the first have been widely studied in the last decades, and therefore, several strategies have been implemented for its conservation, only from the 1990s there has been growing interest for geodiversity. Recently, the International Union for the Conservation of Nature (IUCN), the institution responsible for the nature conservation in the world, has recognised geodiversity as an integral part of nature and geoheritage as part of the natural heritage. Despite that, geodiversity and geoheritage are still poorly incorporated in protected area management. In Brazil, protected areas are known as conservation units and regulated by the National System of Protected Areas and administered by Chico Mendes Institute for Biodiversity Conservation (ICMBio). ICMBio is a member of the IUCN, so Brazilian protected areas follow its principles and recommendations for management and conservation. The Itatiaia National Park is the first protected area founded in Brazil in 1937. Considering the whole chain for integrating geoconservation in wider protected area management, a geoheritage inventory was carried out. It aimed to integrate Geoconservation principles in sites' management planning through the generation of key documentation including assessment of actual and potential uses and evaluation of risk of degradation that will be the bases for interpretation. Multiple connexions between geodiversity and other aspects are recognised in the sites "Lakes and wetlands with peat deposits", an excellent example of the link between geodiversity and biodiversity because the rare biota is adapted to the particular abiotic conditions. Also, the sites "Fluted erosion of Agulhas Negras Peak", "Couto-Prateleiras Fault Escarpment" and "Milonitic

Gneiss of Pedra Grande Hill” are examples of sites contributing to the economic development for the surrounding communities through the contraction of environmental monitors and purchase of local products. The integration of Geoconservation in protected area management is an issue that need be addressed. Education and interpretation may be an interesting mean to protect, integrate and disseminate the geoheritage of the protected area system. At the same time, integrated management of geodiversity and biodiversity may contribute to enhancing connections between people and nature, contributing to the conservation of the natural heritage and human well-being.

URBAN GEOSITES: SPECIAL CONTEXT, UNIQUE INTERPRETATION, INCREASED VULNERABILITY

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Day: Thursday

Session Number: 8

Time: 16:05

ABSTRACT:

Urbanization is a global phenomena, expressed by the constant increase of urban population (exceeding 50% globally) and by urban sprawl, the growth of areas covered by infrastructure and housing. Urbanization leads to loss of natural or semi-natural areas, and their isolation to small niches, placing these into a new, urban context. Densification of existing urban areas also adds to the loss of natural environment, destroying biotic and abiotic values.

The geoheritage of urban areas has a special potential for interpretation or geotourism, but it also needs a different geoconservation approach. Geosites without acknowledged values in an inventory or effective protection measurements can be easily destroyed during development projects, although construction work can lead to new geosites as well. Urban geosites can function as interpretation sites on nature in the urban context, giving the geological background of a settlement. Such sites can also raise awareness of geohazards, and be integral in mitigating them. Geosites with hazards, such as rockfall are often destroyed by 'remedial work', especially by concrete coverage. These sites are especially vulnerable by urbanization. However, with effective geoconservation, and consultation with municipal stakeholders, adapted modification can keep the natural aspects, while reducing the risk. Together with biodiversity areas, urban geosites function as niches for flora and fauna, recreation areas for citizens, and potential destinations for tourism.

Here, we present some examples about the current integration of geoheritage to urban management. An urban geosite inventory and management plan was created for Clermont-Ferrand in France. These go from lava cliffs, integrated into the urban fabric, both in private and public domains, to key geosites destroyed through ignorance, and a tale of one author's back garden, where a compromise remedial action was agreed on with authorities.

Several other examples are selected globally from UNESCO-IGCP project 692 'Geoheritage for Geohazards Resilience', calling for the integration of geosites into the urban fabric, improving the resilience of local systems.

GEOHERITAGE, GEOTOURISM AND ENHANCEMENT OF BALZE DI VERGHERETO AND MT. FUMAIOLO PROTECTED AREA (NORTHERN APENNINE, ITALY)

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Day: Wednesday

Session Number: 6

Time: 16:20

ABSTRACT:

The co-existing of geologically interesting and impressive landscapes, together with historical and cultural values, can surely improve the experience of viewers, thus increasing the geotouristic potential of sites and their effectiveness in engaging the public.

That is the case of Balze di Verghereto, a small village in northern Apennines located at the foot of Mt. Fumaiolo (1407 m a.s.l.) and its surroundings, where several geological and geomorphological features are showed as relict or active landforms. The area is included in a protected site (SIC IT4080008) due to its environmental specificities, and comprehends various geosites officially recognized by Emilia-Romagna region, such as Mt. Fumaiolo geosite, that extends from Balze to Sassoni ("big stone blocks") localities, Tevere and Marecchia springs geosites, that represent the catchment areas for the mentioned rivers, both deeply linked to the ancient urban settlements of Rome and Rimini.

The main landforms are strictly influenced by the lithological constraints, above all due to the extensive outcrops of Ligurian and Epiligurian formations. The first ones mainly consist of highly deformed marls and clays (Villa a Radda, Mt. Morello, Sillano and Antognola formations), while the others (Mt. Fumaiolo and San Marino formations) consist of sandstones and biocalcarenes arising from the clays as massive tabular reliefs. Moreover, landscape is modelled by long-term factors (tectonic uplift and weathering processes balancing) and short-term factors, such as different erosional linear and slope processes triggered by lithological conditions and climate events, that produce as a whole gentle hills, Badlands, rockfalls and complex landslides along the calcareous reliefs ridges.

In addition to geological features, meaningful historical sites and cultural testimonies are also widely present, such as the Mt. Faggiola Castle ruins, where Dante was twice hosted when exiled from Florence, St. Francesco route from Rimini to La Verna, that crosses Balze village, and the Gothic Line Park of Badia Tedalda, proposing trekking tours through WWII

places of fight. This landscape has also been linked to the background of one of the most iconic Leonardo da Vinci's portraits, la Gioconda.

Finally, in this paper we propose some solutions to improve the touristic fruition of this area, focusing the attention on the existing relationships between the geological and cultural components.

KARST, CAVES AND SPELEOLOGY AS TOOLS FOR EFFECTIVE COMMUNICATION OF EARTH SCIENCES IN ALTA MURGIA (APULIA, SOUTHERN ITALY)

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Day: Friday

Session Number: 11

Time: 15:25

ABSTRACT:

Earth Sciences are appealing to youngsters (dinosaurs, volcanoes, and fossils taking the lead) but typically do not stand out for communication, and effective transfer of geological knowledge to the wide public is quite problematic. There is a strong need to share information between geologists and people and to support with solid geological data the choices relating to spatial planning according to current and possible geological dynamics.

"Geoparks" and "geotourism" are two keywords that are strongly related to the natural landscape and to what it might offer to the community in terms of culture, environmental awareness and protection, and on-site teaching.

This paper analyzes the possibilities offered by the karst of Alta Murgia (Apulia, Southern Italy), where a National Park was established in 2004. It is an area still experiencing contrasting trends between conservation and planning, in a territory where nature-oriented tourism is not yet fully developed. This strongly contrasts with the fact that, for many Earth Science disciplines, much of the knowledge in the area is due to the speleological research. Several caving clubs are active since the 1950s, that provided significant contributions to knowledge and protection of the Alta Murgia karst, also with remarkable findings such as a complete skeleton of a Neanderthal man.

Findings of such value are not so uncommon, due to the extraordinary importance of the underground environment, nowadays fully recognized in science. The more than 200 karst caves of Alta Murgia are primarily, from an ecological standpoint, isolated habitats where geological records are preserved, contrarily to what happens outside, where erosional processes and human activities cancel them. In addition, caves attract youngsters as well as adults, are linked to many legends and local tales, and are the ideal sites for protection and educational teaching, and to develop and practice scientific laboratories.

In such a context, in Alta Murgia there are several sites highly suitable for on-site learning of the surface and subterranean features of karst, and of their evolution, for the narration of local geological history, for understanding the possible hazards in karst (flash floods, sinkholes, vulnerability of karst aquifers) and, not secondarily, to live an instructive and multidisciplinary outdoor experience that opens to the vision of the deep links existing between geology and evolution of human culture and civilizations.

APPLYING UNMANNED AERIAL VEHICLES TO AESTHETIC CHARACTERISTICS OF TOURISTIC ROUTES IN ASPIRING GEOPARK “BELOGRADCHIK ROCKS”

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Day: Friday

Session Number: 11

Time: 15:45

ABSTRACT:

Aspiring geopark “Belogradchik Rocks”, considered the most famous geological monument in Bulgaria, is based on the beautiful rock pinnacles formed in the Lower Triassic red sandstones, complemented with a remarkable geodiversity of sedimentary, igneous, volcanic and metamorphic rocks. There are dozens of geosites that correspond to the context of the main theme of the Geopark: geological phenomena, landscapes and their relation with the antique and medieval human history, summarized in 72 well illustrated scientific dossiers.

Touristic infrastructure of the geopark includes five recently elaborated and supported ecotracks. In regard to natural landscape diversity the tracks are concentrated in submontane landscape on Triassic red bed rocks with brown forest soils under oak and oak with oriental hornbeam forests. The most eastern track (“Planiniza”) and the most western one (“Vedernik”) also touch cuetas landscape. In the course of previous field studies we evaluate aesthetic characteristics of each route by applying approach elaborated by Lithuanian geographers K.I. Eringis and A.R. Budrunas (1978). The system includes 28 characteristics of aesthetic quality of landscapes the routes cross through. Its advantage is that all indicators are elementary in order to minimize subjectivity of an observer. However, such field surveys

are labor-intensive and spatially limited. Applying unmanned aerial vehicles (UAV) makes possible to measure most aesthetic characteristics of landscapes surrounded of existing or planned routes on the entire territory of geopark.

Aerial photographic survey performed using DJI Phantom 4 produced orthophotomap, DEM and image-derived indices. The spatial resolution of these cartographical products is about 1m. The cartographical products were used to generate panorama for 10 viewpoints located on touristic route. Remote sensing allow measuring 21 of 28 aesthetic characteristics of landscapes such as depth and diversity of perspective view, virginity of landscape, number of mountain peaks and slopes; shape of skyline; manmade features and their correspondence to natural landscapes. We compared the results with field surveys and found their good compliance.

References

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IDENTIFICATION AND ENHANCEMENT OF GEOLOGICAL, GEOMORPHOLOGICAL AND GEOGRAPHIC ELEMENTS FOR A GEOPARK PROPOSAL IN THE QUEBRADA DE HUMAHUACA (NORTHWEST OF ARGENTINA)

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Day: Friday

Session Number: 12

Time: 16:50

ABSTRACT:

The Quebrada de Humahuaca has a long geological history. Its wide variety of rocks and geofoms is the result of a plurality of geological processes, which took place at different periods in its evolutionary history, and can be evidenced in the selected Geological Interest Sites (GIS). The sites are as follows: The Ondulitas (550 Mya.) Discordance Tilcárica (550 Mya.) The Fossils of Salto Alto (500 Mya.) The Dinosaur Footprints, Paseo de los Colorados, the Casata (65 Mya.), the Garganta del Diablo, the Espejo de Falla, the Cabalgamiento, the Paleta del Pintor, Cerro de Siete Colores (50 Mya.), the Cone de Volcán, (2.5 Mya.) the Badlands, and Meteorite Impact (Recently). The SIG's faithfully represent the geological characteristics of the Quebrada and achieve an important representativeness of the processes that occurred in it throughout its geological history, allowing to identify the presence in the area of geodiversity elements that illustrate a remarkable geological variety. GISs are heterogeneous in time and in geological processes involved. Regarding its frequency, there is no repetition between the sites. Thus, each GIS is the result of unique phenomena, it reveals a different development either in geological time, lithological origin or in the processes that originated them. The geoheritage of the area has a high singularity and the integration in the environmental interpretation of the landscape of the geological and geomorphological characteristics will be doubly perceived, under the structure of a Geopark, which also guides actions towards consistency with the service to visitors. The cultural history of the Quebrada de Humahuaca, in which justifies its two UNESCO declarations, as a World Cultural Heritage Site in 2003, and as a section of the Qhapaq Ñan Cultural Itinerary, in 2014, it is proposed to add these fourteen GIS for the reconstruction of its geological history, giving account of the commitment to the enhancement of the geological processes and the landscape of Quebrada, product of these geological processes and the presence of man some 10,000 years ago. Given everything said so far, added to the connectivity of the area with respect to the GIS and the socio-economic structure based on cultural tourism, a geopark in the Quebrada would contribute to the conservation of the memory of the Earth.

GEOTOURISM AND LOCAL DEVELOPMENT IN FOGO VOLCANIC NATURAL PARK, CAPE VERDE

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Day: Friday

Session Number: 10

Time: 14:10

ABSTRACT:

Volcanic eruptions constitute a threatness for people who live around them. However, volcanoes offer too numerous opportunities to the local communities living in volcanically active regions. The aim of this work is to study the natural and cultural heritage with potential use for geotourism and develop new tourist products in the Fogo volcanoes that contribute to promoting local development on this island as well as to focus on the possibility of creating new products as the volcano-tourism in Fogo for local development. Fogo island is located in the southern group of Cape Verde, about 600 km from the west tropical coast of Africa. The Fogo Natural Park (FNP) is located on the summit of the active volcanic island and has an important natural and cultural resources associated to the volcanic heritage (caldera, composite volcano, monogenetic cones, lava fields, deposits, ravines, unique plant landscapes and forms of agricultural use and small villages). The original resulting volcanic landscape is the result of a harmonious combination of natural resources with the agricultural uses of this tropical volcanic island. The last eruption (2014-2015) took place within the FNP and formed multiple cinder cones and pahoehoe and aa lava fields that destroyed Portela and Bangaeira villages. The most important economic activities of FNP are agriculture, livestock and geotourism. The methodology is based on a non-systematic inventory of resources from FNP, aerial photos analysis and fieldwork. The scientific literature about volcano tourism shows eight main attractive: landscapes, eruptions, hot springs, ecology, sports, sand beaches, cultural parks and religious traditions. Taking into account these touristic attractions, we propose new products based on volcanic heritage and the type of eco-tourists that arrive Fogo

island. The main resources for the geo-tourism in FNP are the trails to the top of Pico stratovolcano as well as routes visit and know about the culture of the territory focused on the production of wines and gastronomy. Currently, Fogo island has a touristic map with 13 trails in which are detected the main resources of the Island and of the FNP associated with the volcanic heritage. So, visiting the FNP, is easy to observe all the volcanic resources described in the scientific literature. These volcanic landscapes show the great opportunity for geotourism and the local development.

GEOHERITAGE IN MOROCCO: CURRENT STATE, TRENDS AND PERSPECTIVES

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Day: Friday

Session Number: 12

Time: 16:45

ABSTRACT:

Morocco is increasingly engaged in a process of protection and promotion of its Geoheritage, aligned on the strategies adopted by several countries. This commitment, reinforced by the quality of its geodiversity, has brought it to be recognized as the first African and Arab country to set up a labeled UNESCO Geopark in 2014, the M'goun Geopark. Since then, Geoheritage has become a national focus on its own. Furthermore, the government started the preparation of legal frameworks to protect national geological heritage, particularly the paleontological elements. A real interest centered on the Geoheritage tryptic “identification, protection and promotion” has raised among Moroccan scientists, from different backgrounds. The increase of Geoheritage interest and studies is explained by at least two major aspects: (i) the important and unrecognized Geodiversity which worth Morocco to be called the “Geologists paradise”; (ii) and the significant role that Geoheritage plays within the development of the territories and the socio-economic life of the local populations. Moreover, the setting-up of the African Geopark Network (AGN), in 2019, has catalyzed awareness rising at the national and continental scale with the purpose of further promoting research linked to Geoheritage.

Here we present a summarize of the published papers, related to Geoheritage in Morocco and intend to provide a synthesis of the existing literature. The present study aims, firstly, to provide the current state of the researches on Geoheritage in order to identify the trends and the themes of interest. Thus, an overview of the assessment used parameters and related criteria will be given. Accordingly, a preliminary national geosites inventory could arise. In addition, we target establishing an open and non-exhaustive database for all those interested in Geoheritage studies.