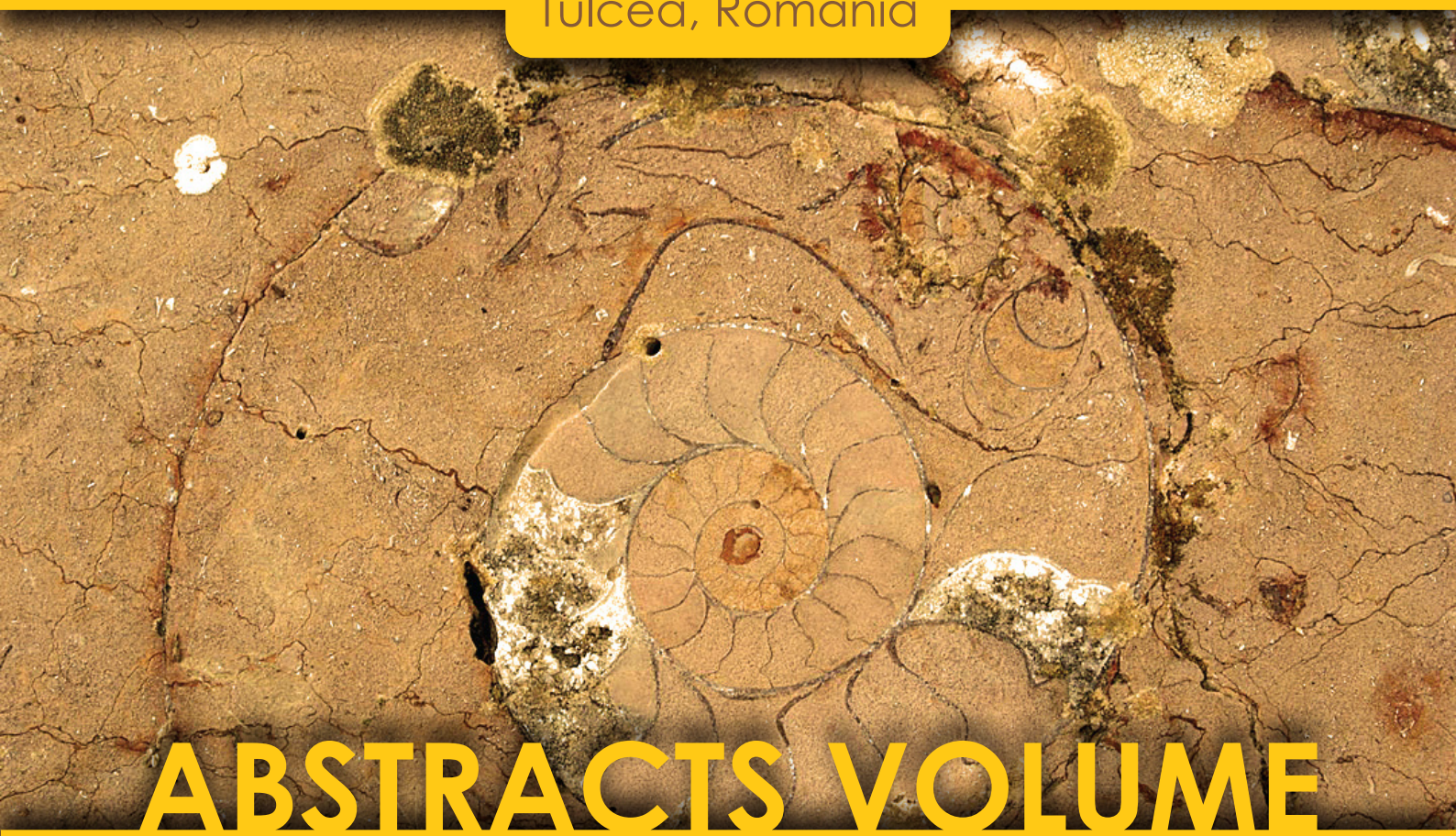
XIIth International ProGEO Symposium

Celebrating Geological Heritage and Geoparks

EDITORS: Andrei Briceag, Antoneta Seghedi

30th September - 2nd October 2025,
Tulcea, Romania



ABSTRACTS VOLUME

GeoEcoMar, Bucharest, 2025

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GEOSITE DELIMITATION AS AN ESSENTIAL TASK IN GEOHERITAGE MANAGEMENT: THE EXAMPLE OF PENEDA-GERÊS NATIONAL PARK, PORTUGAL

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Keywords: Inventory, conservation strategy, Variscan granites, glacial processes, landforms

Peneda-Gerês National Park (PGNP), the only national park in Portugal, is the country's most significant protected area, designated for the uniqueness of its natural and cultural landscapes. Established in 1971, the park spans 709.2 km² and encompasses most of the Peneda, Amarela, and Gerês mountain ranges. The geoheritage of PGNP is predominantly geomorphological in nature, characterized by Variscan granites that shape distinctive landforms such as tors, castle kopjes, and bornhardts. Evidence of Pleistocene glacial processes is preserved in various landforms, including U-shaped valleys, cirques, polished and striated granite surfaces, moraines, and subglacial till deposits. Several of these geodiversity features have been recognized for their high scientific value and are included in the national inventory of geosites (Brilha & Pereira, 2020). A successful geoconservation strategy involves multiple sequential stages, beginning with the inventory of geoheritage (Brilha, 2005). This stage identifies valuable geodiversity elements, thereby defining geosites. The delimitation of geosite boundaries is a critical component of this process, as it specifies which elements are encompassed within each geosite and supports effective management and conservation actions. Clearly defined boundaries are essential for policy development and implementation, facilitating informed decision-making by management authorities (Santos-González & Marcos-Reguero, 2019). The geoheritage inventory of PGNP was conducted by integrating previous partial inventories with the identification of new sites. An initial assessment based on scientific value led to the selection of 12 nationally significant geosites. Preliminary boundary delineations were established for these sites using a method that considers the scientific relevance and density of geodiversity elements, as well as the spatial type of each site (e.g., discrete points, broader areas, or panoramic viewpoints). This study forms part of a broader evaluation of PGNP's geoheritage and aims to support a more accurate assessment of geosite values, including their educational and touristic potential and their vulnerability to degradation. Furthermore, it seeks to inform geoconservation strategies by integrating the mapped geosites into management tools such as the PGNP Management Plan.

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BUILDING UNESCO GLOBAL GEOPARKS IN ROMANIA

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Keywords: Geoparks, Geodiversity, Geoconservation, Cultural identity

The development of the geopark concept has several clear milestones: the *Digne-les-Bains Declaration* in France (1991); the creation of the European Geoparks Network, based on four LEADER territories (2000); the establishment of the Global Geoparks Network (2004); and the UNESCO Geoparks Program (2015). As of 2025, the Global Network includes 229 territories in 50 countries**,** with new projects ongoing worldwide. Many entities and individuals have contributed to the success and development of this concept, but three organizations have had a major role: the Global Geoparks Network, UNESCO, and ProGEO, particularly in Europe (Zouros & Martini, 2003; Frey, 2003; Martini, 2009).

The adaptation and development of the geopark concept in Romania began over 30 years ago, building on experience gained through participation in ProGEO activities and cooperation with three of the founding territories, namely Haute Provence, Vulkaneifel, and Lesvos. Our approach has focused on maintaining a balance between the international requirements and the adaptation to local socio-economic and cultural realities. Different management options have been taken into consideration. Andrăşanu, 2010; Marinel et al., 2025). All geopark projects in Romania started from scratch, with a bottom-up approach and based on partnerships and multidisciplinary research studies.

The territory is the fundamental element and has to meet the following criteria: i) geology of international significance; ii) a balanced network of geological, natural, and cultural features; iii) optimum surface to allow management and development; iv) well-defined cultural and historical identity; v) partner communities with economic, social, and cultural affinities able to work together.

Currently, Romania has two UNESCO Global Geoparks: Hateg Country and Buzău Land; two aspiring geoparks: Oltenia de sub Munte and Carpaterra; and two geopark projects: Cimerian Dobrogea and Gutâi–Maramureș, along with more than eight potential territories.
Close cooperation with the National Commission for UNESCO was a key step in establishing the Geopark Forum in 2016 and the National Geoparks Network in 2024. A Geoparks Charter was developed to support the development of existing geoparks and guide new initiatives toward a coherent approach. The University of Bucharest serves as the academic partner for all projects and manages the UNESCO designation of Hateg Country

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SPELEOLOGICAL HERITAGE, AN IMPORTANT PART OF KOSOVO'S GEOHERITAGE

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Key words: karst, heritage, speleological objects, cave

Introduction. Speleological heritage occupies an important place within the geoheritage of Kosovo. The area of the karst terrains in Kosovo is about 1,506 km^2, or 13.81% of the entire area. In Kosovo, 20 objects of speleological heritage are protected (Çadraku & Bajraktari, 2024). The most important geoheritage areas are: Bjeshkët e Nemuna, Sharri Mountains, Pashtrik Mountains, Mokna Mountains, Gadime Cave, Mirusha Waterfalls, etc. These areas are distinguished by important national and international values.

Methodology. For the realization of this work a number of scientific methods have been used, such as: the literature research method, the direct field observation method, the GAM method (Geosite Assessment Method), the GIS method. With the application of GIS, GPS, satellite images, orthophotos, a database of speleological objects has been established a, which will be used for further geographical analysis (Bajraktari & Behrami, 2022; Bajraktari et al., 2024a, b).

Results. Speleological objects, as an important part of the geoheritage in Kosovo, include:

- Gryka e Madhe Cave (The Great Canyon Cave), Radac Cave, Panorci Cave, Kusari Cave, Devetaku Cave are the most representative speleological objects with great hydrological values;
- Gryka e Madhe Cave (The Great Canyon Cave) (13,950 m), Radaci Cave (3,620 m), Gadime Cave (1,250 m), Dushi Cave (670 m), Panorci Cave, (955 m) are the largest speleological objects in Kosovo and have extraordinary geomorphological values;
- Gadime (marble) cave was created in Paleozoic limestones and it is among the rare speleological objects in Kosovo and the region that formed in marble;
- Radaci Cave, Nakoc Cave, Dema's Cave and Zatriqi Cave represent archaeological sites and important speleological objects with cultural and historical values;
- Radaci Cave, Nekoc Cave, Dushi Cave, Zatriqi Cave are speleological objects with faunal values and potential areas for the Natura 2000 ecological network.

Conclusions. Kosovo, with its diverse and interesting geoheritage, has many speleological objects that deserve the status of national and international heritage, but these values must be studied in detail and declared protected on the basis of scientific argumentation.

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DEVELOPING MONITORING INDICATORS FOR GEOLOGICAL SITES: A METHODOLOGICAL APPROACH

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Keywords: geoconservation strategies, geoindicators, geodiversity sites, geosites, Brazil

Geological site (GS) monitoring involves the analysis of attributes and values over time in the face of its fragility and vulnerabilities (natural and anthropic). To conduct effective monitoring strategies, indicators are used to measure geological processes and their impacts. To assess the conservation status and public use of GSs along the northern coast of the state of São Paulo, a methodology was proposed to identify relevant indicators. The procedures consist into three main steps: i) definition of management priorities according to quantitative assessment developed by Higa (2019) for the 88 inventoried GSs, complemented by criteria including medium to high scores for educational and touristic value, presence of both active and non-active processes, varying protection regimes, exposure to anthropogenic and natural threats, and the inclusion of at least one GS per municipality; ii) creation of a geological-environmental units map based on Ramos et al. (2018); and iii) correlation of parameters obtained from mapping and literature review. As a result, five GSs were selected for monitoring, and six geological-environmental domains, comprising sixteen units, were defined. The selected GSs are located within the Predominance of orthoderived migmatites (DCGMGLmo), Peraluminous granitoid (DCGR1pal), Deposits with predominance of colluvium and subordinate talus (DCICT_Co-T), and Holocene to present coastal marine environment (DCmc_Dmar) units. Among the set indicators derived from unit descriptions and literature review, the following were elected for monitoring the five GSs: human-induced weathering for Pedra do Sino (1), landslides for the Guaecá leucogranite type-locality (2), landslides, precipitation, and water level for Landslides records of Caraguatatuba (3), coastal erosion and wooden trunks deposits for the Severe erosion on Barra Seca Beach (4), and coastal erosion and human-induced weathering for the Pleistocene marine terrace of Vermelha do Norte Beach (5). The geological-environmental framework proved suitable for the regional context and was particularly effective in identifying physical and chemical indicators, referred to as geoindicators. The selected indicators will contribute to the monitoring of GSs, supporting the assessment of changes in natural processes, the impacts on non-active GSs, and ensuring safety for public use.

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3D PHOTOGRAMMETRIC MONITORING OF GEOLOGICAL SITES: INITIAL ASSESSMENT FROM PEDRA DO SINO, NORTHERN COAST OF SÃO PAULO STATE, BRAZIL

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Keywords: geoconservation, indicators, human-induced weathering, digital technology, touristic site

The Pedra do Sino (Bell Stone) is a culturally significant geological site (GS) known for the metallic sound it produces when struck with a hammer (Fig. 1a). Located in the municipality of Ilhabela, on the northern coast of the state of São Paulo State, Brazil, the site comprises several phonolite boulders distributed across approximately 678 meters of coastline. These rocks originated from an 80-Ma alkaline magmatism event. The boulders exhibit abundant indentation marks and white blotches resulting from repeated hammer impacts (Fig. 1b), especially on three of these located along a footbridge. To support conservation strategies aimed at preserving the site's value and sustainable use, a monitoring programme was initiated to assess human-induced weathering. The monitoring relied on 3D models generated via photogrammetry using the Structure from Motion (SfM) method (Carrivick et al. 2016).

Fig. 1. Monitoring steps at the Pedra do Sino geological site: a) Overview of the site, with boulder 1 highlighted in yellow, boulder 2 in red, and boulder 3 in blue; b) Identification of indentation marks resulting from human activity; c) Photographic documentation of boulder 2, the main boulder frequently struck by visitors, located at the end of the footbridge; d) Example of a 3D mesh model of boulder 2 generated using photogrammetry; e) Example of a curvature map of boulder 2; highlighting wear marks.

Initial data acquisition was performed using a wide-angle camera and followed three main steps: i) a total of 111, 123, and 78 photographs were taken of boulders 1, 2 (Fig. 1c), and 3, respectively; ii) 3D modelling was carried out using the Agisoft Metashape software (Fig. 1d), involving photo alignment, mesh creation, masking, and geometric calibration; photos were then realigned using the masks to reduce error, resulting in the final 3D meshes; iii) quantitative data acquisition included manual measurement of 13 selected features - 6 on boulder 1, 4 on boulder 2, and 3 on boulder 3. These features ranged from 8.9 to 45.0 cm in width, 8.7 to 39.6 cm in height, and 0.4 to 9.1 cm in depth. Curvature maps were produced in the Meshlab software (Fig. 1e) to visualize the volume and distribution of wear marks. Preliminary results suggest that the white blotches represent the initial stage of the degradation process, as visitors tend to strike these spots. Future data acquisition will support a time-series analysis to detect surface changes in detail. The digital tools employed in this study provide valuable insights for the development of a management plan for the GS.

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AN ASSESSMENT OF WATER QUALITY OF LAKE SEFERANI

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Keywords: pH, dissolved oxygen, TSS, turbidity, NIVA, diatoms

To achieve the protection and conservation of geoheritage, with the objective of designing mitigation measures, Environmental Impact Assessment (EIA) represents the best tool to reach these objectives (Bruschi & Coratza, 2018). Lake Seferani has been designed as a Natural Monument in the Republic of Albania (AKM, 2021). The Assessment of the quality of natural, surface waters, is of particular importance, especially for all those waters whose main use is the growth of aquatic flora and fauna (Bode et al., 2024; Zelinka & Marvan, 1961). The calculated sedimentation rate was 1.76 cm/yr, considered relatively high, due to the strong erosion form the surrounding watershed. The diversity of diatoms found in Seferani Lake can be considered high. About 145 taxa of microscopic algae, diatoms (*Bacillariophyceae*), were found, represented mainly by the genera *Navicula* (*25 species*), *Nitzschia* (20), *Cyclotella* (14), etc (Rott et al., 2003; Krammer& Lange-Bertalot, 2005). Seferani lake has neither inflows, nor outflows, and it is often filled by rainfall; therefore, its water level oscillates drastically during the year.

Measurements were carried out and data were obtained at 7 stations at different depths in the waters of Lake Seferani in the period May 2019. General physicochemical parameters that were measured in situ: pH, dissolved oxygen, total solids (TSS), turbidity. The WTW multiparameter 340i was used.

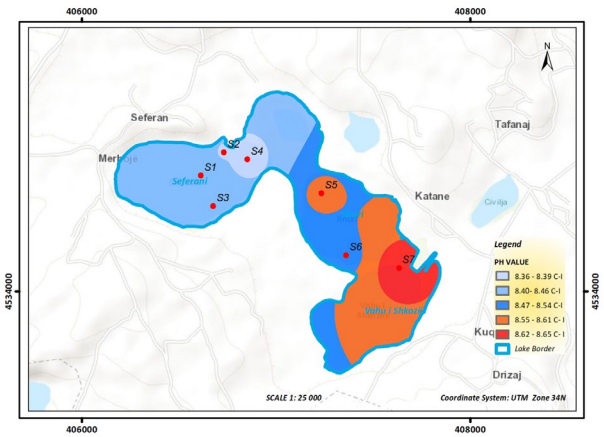

Fig. 1. Ph values measured in Lake Seferani

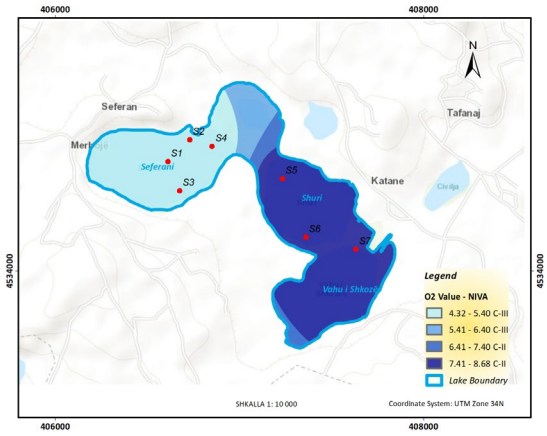

Fig. 2. O2 values measured in Lake Seferani

The results of measured physical and chemical parameters show that the waters of Lake Seferani, classified according to Norwegian Institute for Water Studies (NIVA), are ranked: class III for dissolved oxygen, class I for pH and class V for suspended solids and turbidity (Fig.1-4), corresponding to scarcely polluted to moderately polluted water quality. The terrigenous hilly relief, the typical Mediterranean climate characteristics combined also with poor land use activities (land denuding), might be the principal causes of the relatively high rate of sedimentation observed on Seferani Lake.

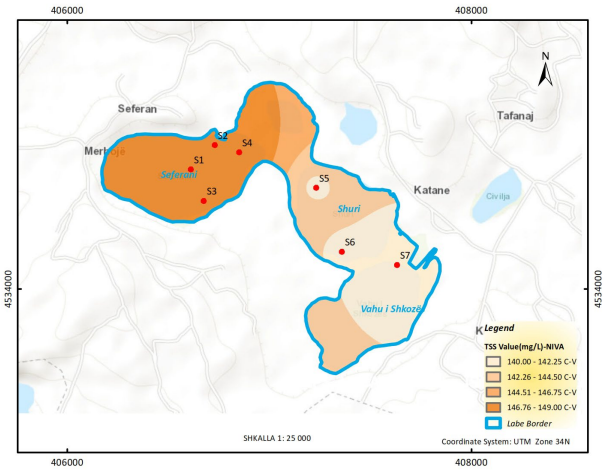

Fig. 3. TSS values measuresd in Lake Seferani

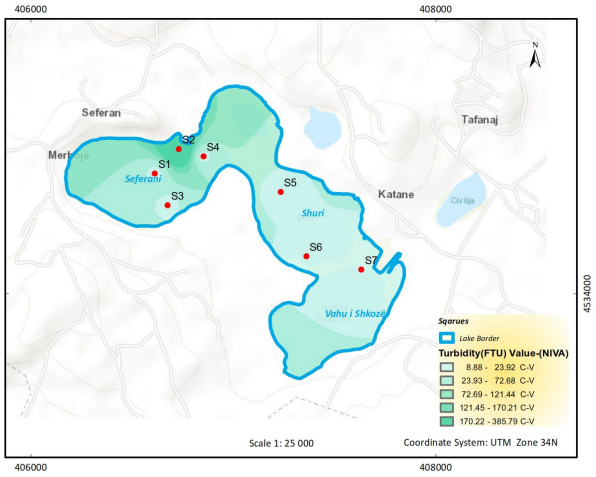

Fig. 4. Turbidity values measured in Lake Seferani

The decentralized management of wastewater is recommended to prevent the eutrophication processes and protect the water quality of the lakes. Moreover, forestation activities, especially in denuded areas, would restore the vegetation cover and decrease erosion.

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UNESCO CHAIR ON GEODIVERSITY AND GEOCONSERVATION: STRENGTHENING INTERNATIONAL COOPERATION AND INNOVATION

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Keywords: geoheritage; networking; capacity building; best-practices; communication

The University of Minho (Portugal), in collaboration with 12 partners (10 universities and 2 international organisations) was recently awarded with a UNESCO Chair dedicated to geodiversity and geoconservation. Established in 1992, the UNESCO Chairs Programme includes 1061 Chairs across 125 countries, addressing high-priority topics for UNESCO and for participating institutions. A UNESCO Chair consists of a team of academic staff and postgraduate students working to advance knowledge and best practices through projects related to education, the natural and social sciences, culture and communication.

The UNESCO Chair on Geodiversity and Geoconservation is focused on research, training and awareness-creation in these interconnected fields through the lens of geological heritage. It will address four main challenges:

1. Education, Awareness and Public Engagement: Many stakeholders and the general public are not fully aware of the value of geodiversity in enhancing human and ecosystem well-being. Raising awareness, promoting education and providing training on the significance of geodiversity and geoheritage are crucial to fostering support and encouraging a holistic approach to nature conservation.
2. International Cooperation: The project will facilitate international collaboration among South-South and North-South partners to address shared challenges and exchange best practices in geoconservation.
3. Research and monitoring: The Chair will support research and monitoring efforts to inform site management decisions and provide training to enhance conservation strategies.
4. Climate change and other environmental threats: As geoheritage is increasingly affected by impacts of climate change and other environmental pressures, the project will integrate climate resilience and mitigation strategies into geoheritage management plans.

Effectively managing geodiversity and geoheritage within UNESCO-designated sites and other conservation areas aligns with UNESCO's broader mission, encompassing natural and cultural heritage preservation, scientific research, education, sustainable development, and international cooperation. This comprehensive approach ensures the lasting significance of these areas for current and future generations.

THE BOUISSONE SHALE GEOSITE: GEOHERITAGE ASSESSMENT AND GEOTOURISM POTENTIAL IN THE JEBILET MASSIF, MOROCCO

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Keywords: Bouissone's Shales; Late Visean, geotourism, sustainable tourism

This study evaluates the geoheritage significance and geotourism potential of the Bouissone Shale formation within the Jebilet Massif, Morocco. The Visean-age shale sequences (ca. 330 Ma) exhibit exceptional structural characteristics, displaying near-vertical bedding planes that represent significant geoheritage assets warranting systematic conservation strategies. The geosite demonstrates high scientific value through its well-preserved Lower Carboniferous marine sedimentary sequences, providing critical insights into Paleozoic depositional environments and Variscan deformation processes. The spectacular vertical orientation of black shales results from intense tectonic deformation during the Late Visean-Early Westphalian orogenic phase, creating a natural laboratory for studying structural geology. These features possess exceptional representativeness within the North African Variscan belt, contributing to global geological significance. Geoheritage assessment reveals outstanding educational potential, ranked highly for interpretive value, accessibility, and capacity to communicate complex geological concepts to diverse audiences. The site's aesthetic appeal and dramatic visual impact enhance pedagogical effectiveness, supporting both formal geological education and informal learning experiences. Geotourism evaluation indicates significant potential for sustainable tourism development, contingent upon appropriate interpretation infrastructure and visitor management strategies. The site's proximity to existing transportation networks enhances accessibility, while its geological uniqueness provides competitive advantages for niche geotourism markets. Results demonstrate high scores across multiple evaluation criteria, positioning the Bouissone Shale as a priority site for geoheritage conservation and geotourism development. Conservation recommendations emphasize integrated management approaches balancing scientific preservation with sustainable tourism utilization, requiring immediate attention for maximizing contribution to geological education and regional development.

THE NATURAL FOUNDATIONS OF INDUSTRIAL HERITAGE: RECOGNISING GEOHERITAGE WITHIN INDUSTRIAL SITES

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Keywords: Mining Heritage, Cultural Heritage, Natural Heritage, Nord-Pas-de-Calais, France

Industrial heritage is typically recognised under cultural heritage frameworks at an international scale, yet many of these landscapes are fundamentally rooted in natural heritage, especially geological. The materials extracted, the landforms exploited, and the landscapes transformed were all provided by this underlying geological heritage. However, as geoheritage is grouped with natural heritage, it is frequently overlooked within cultural classification systems. This paper examines how industrial heritage is defined and designated at different scales, revealing a disconnect between national recognition of geological value and international emphasis on cultural significance.

Using the Nord-Pas-de-Calais Mining Basin as a case study, this paper explores how post-industrial landscapes are classified as natural heritage within France's National Inventory of Geological Heritage (INPN) but designated solely for its cultural heritage value by UNESCO. This discrepancy is not unique: other industrial World Heritage Sites, such as the Cornwall and West Devon Mining Landscape and Blaenavon Industrial Landscape (UK), show similar patterns. Through policy review and comparative analysis across France, England, and UNESCO frameworks, it is argued that the current separation of natural and cultural categories creates a form of 'hidden geoheritage' through categorising industrial heritage within cultural heritage and geoheritage within natural heritage. Either the current definitions need to be revised to ensure that geoheritage is recognized within industrial heritage sites, or a formal mixed classification should be adopted.

This oversight also has wider implications. In post-industrial regions experiencing economic decline, international recognition plays a vital role in re-establishing community pride and attracting tourism. However, when only cultural aspects are recognised, local narratives and the businesses that emerge to support this 'heritage tourism', may exclude the geological story altogether. Over time, this further conceals the natural features that made industrial development possible.

This paper proposes that industrial landscapes be reclassified as *cultural geoheritage*, recognising their dual identity. It calls for a more integrated approach to designation, through UNESCO's mixed heritage category or alternative frameworks that honour the relationship between humans and nature. Recognising geoheritage within industrial heritage is not just a matter of academic clarity but essential for accurate interpretation, sustainable tourism, and meaningful community connection to place.

IMPACT STRUCTURES: ATTRACTIVE DESTINATIONS FOR GEOTOURISM

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Keywords: meteorite crater, Chernyakhiv culture, ring structures, geological tourism, meteorite type

Impact structures remain one of the most interesting objects of geological tourism in the world today. Unfortunately, scientists often struggle to identify the imprints of many impact events because craters or furrows frequently vanish due to erosion or become obscured by sedimentary rocks, making them hard to locate. When impacts occur in bodies of water, they typically leave no visible traces. Additionally, many craters lack fragments of meteorite material, complicating the interpretation of their ring structures (Valter et al. 2000).

In Ukraine, eight impact structures are known, their formation times ranging from 445 million years to 40 million years (Gurov & Kelli, 2003; Derevska et al., 1980). The largest impact crater in southeastern Europe is the Bovtyshka crater, located in the Kirovograd region of Ukraine, which was formed approximately 65 million years ago and has a diameter of 24 km. A notable comparison is the Chicxulub crater in Mexico, which dates to the same period.

An exceptional impact structure can be found in the Vinnytsia region of Ukraine: the Illintsi meteorite crater, which is the oldest known in Europe, having formed 445 million years ago. This site has been extensively studied by both Ukrainian and foreign scientists (Khavlyuk, 1980) and exhibits traces of ancient mining dating back to the 3rd century AD (associated with the Chernyakhiv culture). The discovery of the Illintsi quarry by archaeologists has significantly contributed to our understanding of the production and economy of ancient civilizations in Ukraine. In small quarries, on the southwestern edge of the structure, zeuvites, tagamites, impact bombs and breccias were discovered. The impactites are characterized by porous, weakly fractured rocks; however, fresh specimens appear dense and non-porous, containing inclusions of xenoliths from the target rocks (Derevska et al., 2020).

Based on European and Ukrainian experience, using the existing geological monument and guidebook, we propose a collective project: “Development of the concept and creation of a geological park, museum and educational centre “Illintsi Geopark” within the framework of the development of geological tourism in Ukraine in the post-war period.

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FERRICRETE IN BERKSHIRE CHURCHES (UK) – AN UNUSUAL BUILDING STONE

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Keywords: Quaternary, duricrust**,** conglomerate, gravels, construction, Medieval times

Berkshire is a county in the south of the United Kingdom. The bedrock is mainly Cretaceous chalk, Palaeogene sand and clay with extensive river terrace gravels along the river valleys. This limits the available building stone and use has been made of other materials such as brick, flint, imported limestone from adjacent counties. In the east of the county, churches built near to the river valleys use has been made of a hard, iron rich conglomerate, ferricrete. On behalf of Berkshire Geoconservation Group a survey was conducted to find the extent of the use of ferricrete and also to link it to certain horizons or Thames River Terraces. Good examples can be seen in churches which originate from Medieval times, but little is found in walls or other buildings as few remain of from that time.

Ferricrete is a dark brown material, that is often used as a building stone due to its hardness and durability. It comprises of pebbles, often flint, which have been cemented with an iron rich cement due to changes in groundwater chemistry, the reaction time and temperature changes. Ferricretes form in hard layers that are known as duricrusts. There are few *in situ* examples of the ferricrete as it has largely been removed from fields etc., when these have been ploughed. Examination of these unusual stones in church walls and monuments offers a good insight into the changing deposition environments during the Quaternary.

The survey found that ferricrete was used in early Medieval times and quarried from nearby sources and provided a hard building stone when other local rocks are much softer. Almost all of the churches where it is found are close to Thames River gravels deposits of varying ages from the Quaternary. The clasts within the ferricrete vary from one source to another and reflect to age of the deposit. River Terraces 2 and 4 are most commonly used. Prior to the survey, only about six churches were known to use ferricrete, but it is now apparent that there are many more and they do map well to the River Terrace deposits.

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OTKRITIÉ: A UNIQUE SPACE FOR SHOWCASING THE GEOLOGICAL HERITAGE OF NORTH MACEDONIA

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Keywords: heritage stone, exhibition, education, gallery, sustainable development, ruby

Northern Macedonia is a country in the Balkan Peninsula. It is surrounded by Serbia to the north, Bulgaria to the east, Greece to the south and Albania to the west. With a surface area of around 25,000 km², the country boasts considerable geodiversity for its size, in terms of both lithology and stratigraphy.

Otkritié (eureka in Macedonian) is a cultural and naturalist association that aims to develop and promote the geological heritage of North Macedonia. Created in 2023, it is based in Skopje. The association has opened a venue close to the city center, with showcases and educational resources to welcome the public (school children and tourists).

In two years, Otkritié has several projects underway. In addition to a permanent exhibition of geological objects, a first exhibition of Macedonian heritage rocks linking their use in architecture has been set up. A project for a tour of the rocks in the center of Skopje is currently under development with an association of architects and the National Faculties of Geology and Architecture of the Cyril and Methodius University. Otkritié is also involved in promoting Macedonian geology as part of Ministry of Culture projects involving the Macedonian Cultural Centers at Macedonian embassies abroad. The Association is also currently involved in a project to promote a locality (Galičnik) as part of a territorial development scheme linking nature, geology and sustainable development. Galičnik is well known in Northern Macedonia for its local culture (plant and herbal tea production) and traditional customs (wedding venues, dress, folk songs and dances). These initial exchanges have given rise to a bottom-up approach to sustainable development, typical of a UNESCO Geopark project. Finally, Otkritié wishes to promote and protect the Macedonian ruby appellation. Indeed, the country possesses deposits of this mineral, yielding gems that have historically been exploited in the country's jewelry art in the form of typical ruby cabochons.

Otkritié's diversity makes it a uniquely unifying project in North Macedonia, with the ambition of promoting and protecting the country's geological heritage.

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GEOLOGICAL HERITAGE INVENTORY OF URUGUAY BASED ON GEOLOGICAL FRAMEWORKS

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Keywords: Uruguay, geological heritage, geological frameworks, inventory, geoconservation

Although Uruguay is a small country in the South American context, its geology is complex and varied from a lithological and structural point of view. Its geological records range from the Archaean to the Phanerozoic, which means that its territory encompasses geological domains that represent a large part of the Earth's history. Despite its recognized geodiversity, the study of geological heritage is lacking, and inventories of geosites have only been carried out in geopark territories. In recent years, work on geological heritage in Uruguay has been consolidated at an academic level, reflecting a growing awareness among the national geoscientific community of the importance of this type of natural heritage, with a focus on its scientific value. However, there is still no systematic knowledge of geological heritage at a national level. It was therefore considered necessary to carry out a methodological approach to evaluating geological heritage at national level through an inventory of sites of geological interest in Uruguay, based on geological frameworks (Faraone Pimienta, 2023). This is a method that has already been applied in European countries and, in Brazil, at state level. It has been adapted here to the specificities of Uruguay, taking into account its territorial extension, the degree of geological knowledge of its territory and the resources available for its investigation. Nine geological frameworks were defined which together represent the country's geological history, as well as a preliminary list of around fifty potential geosites corresponding to these frameworks. This result was achieved with the collaboration of thirty specialists from different areas of geological research in Uruguay, in order to guarantee the necessary scientific consensus which is, among other things, one of the presuppositions for the validation of this inventory method. From the list of potential geosites, two geosites were selected and characterized for each geological framework, according to criteria of scientific value, with a view to producing a model that can be replicated in the near future. It is hoped that the results of this work will serve as the basis for the completion of the national inventory, which is expected to be incorporated into Uruguay's nature conservation legal framework, as well as serving as a contribution to the development of new geopark projects in the country.

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PROMOTING GEOTOURISM IN AREAS OF EXCEPTIONAL BIODIVERSITY: THE CASE OF THE TRANSBOUNDARY PRESPA LAKES BASIN (NORTH GREECE)

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Keywords: Geodiversity, Natural Parks, Ramsar Convention, Sustainability, World Heritage Convention

Prespa Lake and Lesser Prespa Lake (Mikri Prespa in Greek) are two "ancient" adjacent highland transboundary tectonic-karstic lakes in the Western Balkans, shared by Greece, Albania, and North Macedonia. In Prespa watershed, which covers approximately 1,400 km² across the three countries, about 20,000 people live in 69 settlements. Like all "ancient" lakes (e.g. Ohrid in Europe, Baikal in Asia, Tanganyika in Africa etc.), Prespa lakes are characterized by a significant endemic biodiversity. In Greece, as well as in Albania and North Macedonia, joint efforts have been made to protect the entire transboundary region. The area includes four national parks, while some parts – but not the entire lakes – have been separately designated as wetlands of international importance (Ramsar Convention) and are also subject to other protection regimes. In Greece, since 1974 (proclamation of the Prespa National Park), and particularly since 1991 (establishment of the Society for the Protection of Prespa), there has been an intensive and systematic effort to conserve the natural and cultural heritage of the entire Prespa watershed, for the benefit of both local residents and all those concerned, now and in the future (Catsadorakis et al. 2022).

As it is well known that biodiversity and geodiversity are intimately interlinked with each other, this study explores questions like: 1) How can the geotourism aspect be effectively highlighted in a such biodiversity-rich area and 2) Why emphasize the geological aspect and how can visitors be encouraged to engage with the area's geoenvironment, given that for many years, the region's main attraction has been its exceptionally rich biodiversity, including significant endemic plant species, internationally important breeding and wintering water birds, endemic fish, and butterflies, along with its high-quality local products? An initial response to these questions has been provided through the development of 14 trails that integrate the region's rich biodiversity with its cultural heritage, history, and geodiversity (Stranding et al. 2009; Drandaki et al. 2006; Gray, 2004).

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GEOHERITAGE IN THE MUNICIPALITY OF ANSIÃO, PORTUGAL

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Keywords: management, fieldwork, karst, landscape, geotourism

Geoheritage is still a forgotten variable in territorial management policies in Portugal at the local, regional and national scales. There are many causes for this, but there is a crucial step that must be focused since it can really change things and be a changemaker, being promoted by public entities, private sector or both as a strategic partnership.

Ansião is a small municipality with 179 square kilometers and a resident population of near 12000, located in the Sicó Massif, in western-central Portugal, a karst region that is partly a Natura 2000 Protected Area and well known by it´s cultural landscape.

This year the city council of Ansião decided to support the development of a project to identify and evaluate the geoheritage of this municipality by a private company, fully financed by this public entity. This kind of projects is very rare outside of geopark areas in Portugal. This will provide a much strong basis for future strategies of territorial management both at local and regional levels. This project will allow a practical basis to the protection, valuation and promotion of geoheritage in this municipality, allowing the implementation of practical and critical measures for sustainable territorial management focused in geoheritage. It could be also an asset to use in the current process of classification of part of this area as a protected landscape.

Abandoned quarry in Ansião where dinosaur footprints were discovered during fieldwork.

The methodology that is being used has a very important focus, the extensive fieldwork, by foot by a local physical geographer. After searching all the references about this region and an initial analysis being done, fieldwork started already and is expected to take 80 full days and having a total distance of 1500 km covered by foot. It is expected to be finished by the end of September 2025. Despite being still

an ongoing project, many important discoveries were already made concerning geoheritage and are already being studied by palaeontologists, geologists and archaeologists.

There is already a big understanding that the geoheritage of Ansião is under discovered and that there are problems related with their analysis and challenges that have to be faced.

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INTERNATIONALLY DESIGNATED SITES IN LATIN AMERICA AND THE CARIBBEAN: AN OVERVIEW FROM GEOSCIENTIFIC AND MANAGEMENT PERSPECTIVES

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Keywords: geodiversity, geoheritage, international value, nature conservation

Latin America and the Caribbean (LAC) hold a prominent position in global nature conservation and geoscientific heritage, hosting numerous internationally designated areas that reflect the region's exceptional biological and geological diversity. As of May 2025, LAC includes 126 Biosphere Reserves, 13 UNESCO Global Geoparks (UGGps), 33 International Union of Geological Sciences (IUGS) Geological Heritage Sites, 12 Geological World Heritage Sites recognised under UNESCO criterion VIII, and 218 Ramsar Sites that safeguard wetlands of international importance. However, considering the vast size of the region and its remarkable natural wealth, including the two most biodiverse countries globally, it becomes evident that geological sites remain underrepresented in international conservation frameworks.

The distribution of these designations reflects both the environmental richness of the region and the strategic initiatives of individual countries. Mexico leads with 36 Biosphere Reserves, followed by Argentina and Chile. Brazil stands out as a regional leader in geoconservation, with six recognised geoparks and significant contributions to IUGS Geological Heritage Sites in fields such as volcanology, palaeontology, tectonics, and sedimentology. Other countries, such as Peru, Chile, Colombia, and Mexico, also contribute important geological sites, reinforcing the region's scientific significance. Transboundary cooperation is a distinctive feature of conservation in LAC, with initiatives such as the La Amistad Biosphere Reserve (Costa Rica and Panama), the Jaragua-Bahoruco-Enriquillo Reserve (Dominican Republic and Haiti), and the Pampa Charrúa Geopark proposal (Brazil, Uruguay, and Argentina). Geological heritage also transcends borders, as seen in Iguazú Falls (Argentina and Brazil).

Despite the growing number of international designations, concerns remain regarding their effectiveness in ensuring real protection and sustainable management. Recognition alone does not guarantee legal safeguards, monitoring, or enforcement, leaving sites vulnerable to unregulated tourism, land-use change, and resource extraction. Challenges in LAC include weak governance and regional integration, lack of geoconservation legislation, limited infrastructure, difficult access, and land-use conflicts. The absence of Global Boundary Stratotype Sections and Points (GSSPs), with only one candidate in Argentina, underscores the need for stronger scientific engagement, site management, and international collaboration. Ultimately, the success of these designations relies on robust governance, inclusive community participation, and sustained conservation investment.

INTEGRATING GEOCONSERVATION IN LARGE-SCALE EARTH SCIENCE PROJECTS: INSIGHTS FROM THE TRANS-AMAZON DRILLING PROJECT (TADP)

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Keywords: geodiversity, geoheritage, outreach, Amazon rainforest

Large-scale scientific initiatives, such as those by the International Continental Scientific Drilling Program (ICDP), offer remarkable opportunities for advancing geoconservation alongside cutting-edge geoscientific research. Established in 1996, the ICDP supports multidisciplinary drilling projects aimed at deciphering fundamental Earth system processes. These initiatives inherently intersect with geoconservation, generating vast scientific datasets and enabling direct interaction with sites of exceptional geodiversity. We show how outreach activities reinforce the role of geodiversity in supporting local identity and environmental stewardship, aiming for its formal recognition and protection in the Amazon region.

The Trans-Amazon Drilling Project (TADP), conducted within the ICDP framework in the Brazilian Amazon, exemplifies how such projects can actively foster geoconservation. Beyond its core scientific aims, such as advancing the understanding of South American tropical forest evolution, paleoclimate, and hydrology, the TADP integrated a geoconservation agenda. This included systematic identification, documentation, and interpretation of geodiversity associated with drilling locations, alongside efforts to valorise these geological features for their scientific, educational, and socio-environmental significance. Key actions included the development of educational materials for different types of audiences - fossil replicas, 3D models, virtual tours, postcards, an educational booklet, and a colouring book, designed to facilitate public engagement with Amazonian geodiversity. Courses, hands-on activities, and workshops were conducted in collaboration with local communities, schools, and environmental managers, aiming to democratise access to geoscientific knowledge and promote the appreciation of regional geological heritage. The integration of geoconservation strategies within the TADP was further enhanced by the systematic archiving and dissemination of geological data, contributing to the identification of potential geological sites for formal recognition and protection. This approach amplifies the project's scientific legacy and has a major impact, laying the groundwork for future conservation and geotourism initiatives in the Amazon region.

The TADP thus illustrates how ICDP-affiliated drilling projects can serve as powerful platforms for advancing geoconservation, embedding it within broader scientific, educational, and policy contexts. By aligning research objectives with proactive geoconservation practices, such initiatives demonstrate the feasibility and importance of positioning geodiversity management as a core component of large-scale Earth science projects, thereby promoting sustainable development, public engagement, and long-term preservation of geological heritage.

A PROPOSAL FOR ASSESSING GEOSITES TO DEVELOP A FUNCTIONAL AND SUSTAINABLE GEOTOURISM STRATEGY (BEIGUA UGGP, ITALY)

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Keywords: geoconservation, geomanagement, degradation risk, threats, geoheritage

Geotourism plays a key role in promoting local sustainable development, enhancing the visibility of geoheritage, and fostering geoconservation awareness. However, if not strategically planned, geotourism may pose significant threats to geosites (*e.g.*, Fuertes-Gutiérrez et al., 2016; Croft et al., 2020). In this context, we present a methodology designed to support the development of a strategy for sustainable use of geosites as tourism assets. The methodology is composed of three main phases and is particularly suitable for territories aiming to enhance their geotourism strategies or to better valorize their geoheritage. The first phase consists of a qualitative assessment of Touristic Potential (TP), aimed at identifying geosites with the greatest potential to be use as tourism destination. The TP assessment is based on four qualitative criteria: scenery, observation conditions, interpretative potential, and accessibility. The second phase consists of the identification and evaluation of threats to geoheritage at the geopark level, using a risk assessment matrix, that helps prioritize management actions. Finally, the third phase introduces a user-friendly DR assessment tool, designed considering existing methodologies (Vandelli et al., 2024) and structured around three core components with specific criteria to be evaluated: sensitivity (SS; 3 criteria), visitor pressure (VP; 5 criteria), and protection measures (PM; 3 criteria). Each criterion is evaluated using a point-based system. A fourth element, scientific value (SV), is added as a weighting factor, based on the uniqueness and scientific relevance of the geosite. The total score of DR is evaluated using the formula:

$$DR = (SS*SV) + VP + PM.$$

The method was applied to Beigua UNESCO Global Geopark (NW Italy), an area of high geodiversity and with contrasting patterns of tourist pressure between coastal and inland areas. The application revealed different risk levels between coastal and inland area and allowed the identification of the main factors contributing to the potential degradation of geosites, providing targeted recommendations for sustainable site management. This integrative method serves as a practical and adaptable tool for parks, geoparks, and aspiring geoparks seeking to develop or refine sustainable geotourism strategies, while ensuring the long-term protection and valorization of geoheritage.

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FOR SCIENCE AND CULTURE: THE JURASSIC PALAEONTOLOGICAL HERITAGE OF THE "CARSIUM" MUSEUM IN HÂRŞOVA (DOBROGEA, ROMANIA)

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Keywords: museal collections, movable geoheritage, history of science

Central Dobrogea is one of the classic areas of Jurassic carbonate outcrops in Europe (Simionescu, 1907; Arkell, 1956). There, the Upper Jurassic is represented by the marine carbonates with a total thickness of several hundred metres, slight regional dipping of layers and a good accessibility of rock sections (Bărbulescu, 1976; Dragastan et al., 1998). The region is famous for its distinctive geological features, which have been designated important geological heritage sites (Seghedi et al., 2018; Dumitraş et al., 2019). Research into the geology and cultural heritage of this region dates back to at least the beginning of the last century in this endeavour. Mr Vasile Cotovu, a reputable elementary school director in Hârșova city at the time, promoted the establishment of the first provincial museum of antiquities in Romania to collect palaeontological specimens, which are now of high scientific value (Neagu et al., 2014). The museum was formally inaugurated in 1904 by King Carol I and Queen Elisabeta of Romania, and still exists today under the name *'Carsium'* Museum Hârşova. It is now part of the Museum of National History and Archaeology in Constanța. Among the museum's unique relics of antiquity from the area is a rich collection of Jurassic fossils, including ammonites, which Ion Simionescu (1907) elaborated on in his eminent palaeontological monograph. Over the years, part of the museum's palaeontological collection has been sent to various scientific institutions in Romania, including the Geological Museum at the University of Iași or National Geological Museum in Bucharest. After being published and catalogued, this material has become a scientific reference. Some of the collection has remained in situ and continues to grow.

One significant project implemented in recent years was the reconstruction of the historic Elementary School building in Hârșova, led by the '*Carsium'* Museum. The new premises will house the Museum's palaeontological collection and rich archaeological artefacts.

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THE UPPER JURASSIC AMMONITE COLLECTION OF ION SIMIONESCU AT THE "ALEXANDRU IOAN CUZA" UNIVERSITY OF IAȘI (ROMANIA)

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Keywords: ammonites, movable geoheritage, biostratigraphy, GSSP

The Department of Geology at the Alexandru Ioan Cuza University of Iași has a long tradition of geological study and collections, which were initiated in the 19th century by Grigore Cobălcescu, the first professor of geology. The initial collection of 9,000 fossils and minerals, purchased from the German company Kranz, was used to establish the first Palaeontological and Mineralogical laboratories at the university. These later developed into separate museums. Subsequent scientific discoveries have enriched the collections, documenting over 150 years of geological research conducted at this academic centre in Romania. The palaeontological collections are stored at the Museum of Original Palaeontological Collections, located at the current headquarters of the Department of Geology at the Faculty of Geography and Geology of the University of Iași. Of particular note is the collection of Late Jurassic ammonites from Central Dobrogea. This collection contains ammonite guide taxa for the stratigraphic interval between the Oxfordian and Kimmeridgian stages of the Upper Jurassic period, which were originally classified as Oxfordian. The most cited work is probably the monograph by Ion Simionescu (1907), a professor of palaeontology at the University of Iași. In this work, the author described eighteen new ammonite species that have since been recognised as guide taxa in accordance with the current International Stratigraphic Code. The ammonite collection provides complementary material from the sub-Mediterranean region of Romania for the purposes of high-resolution biostratigraphy, in a sensitive interval around the lower boundary of the Kimmeridgian Stage (Upper Jurassic), as defined by the International Stratigraphic Subcommission on Jurassic Stratigraphy (ISJS) in the Boreal section of Scotland (UK). The taxonomic revision of these taxa, which was undertaken by one of the poster co-authors (EG), is aimed at biostratigraphic correlation in the sub-Mediterranean area, with a focus on Romania and Poland, in relation to the Boreal province. To this end, Late Jurassic ammonites from Central Dobrogea in the Palaeontological Museum at the Department of Geology, as described by Ion Simionescu (1907), represent a scientific reference point.

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THE GEOHERITAGE VALUE OF THE CRETACEOUS OUTCROPS FROM THE BABADAG BASIN, DOBROGEA

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Keywords: North Dobrogea, paleontology, sites, limestones, collections, brachiopods

In the last four years, a research work carried out by a team from the Geological Institute of Romania (GIR) in the geological (paleontological) sites from Tulcea County, within the project PN23-39-01-01, reanalyzed the Upper Cretaceous sites in the Babadag Basin. From the existing geological studies on these deposits we must mention the contributions of Mirăuță & Mirăuță (1964), Szász & Ion (1988), and Grădinaru (in Lodowski et al., 2019). We revisited and studied: the Cretaceous limestones from Enisala (Vraconian), with a large assemblage of brachiopods; the small and dispersed outcrop of lumachelique micro-conglomerates from the Lower Cenomanian in Movila Goală Hill (molluscan shell conquina); the Caraburun Hill outcrops; the Baia and Ceamurlia de Jos quarries of Coniacian limestone; the quarries on the Slava Valley (Slava Cercheză, Slava Rusă, Ciucurova, Coșarul Mare) in Turonian-Coniacian deposits; the Caugagia site and all the outcrops and the quarry in Bal Bair Hill; the Codru quarry and its area with small outcrops and thin limestone layers with plants. We assessed the outcrops of Cretaceous layers from the Dolojman and Iancila Cliffs (Promotories) from Razelm Lake. From all these outcrops, a large and valuable paleontologic material collected and studied by previous researchers is stored in many collections of our museum. Newly collected material (preliminary determined) resulting from our field research completes the paleontological heritage of the "Babadag Basin". Recently, three very large specimens of Late Cretaceous (Coniacian) ammonites were discovered during the excavation of a new quarry in the locality of Jurilovca and their study is now in progress. Our analysis aims at the scientific evaluation of each exposure in terms of fossil content, paleontological and biostratigraphic value, or the rarity of the pieces. In addition to these characteristics, based on field observations, we were able to check other parameters of the sites, such as density and dispersion of fossils in strata, development of deposits with fossil content, mode of fossil preservation, association, and state of conservation of the site.

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INITIATIVE FOR A DIGITAL INVENTORY OF ANTARCTIC GEOLOGICAL HERITAGE

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Keywords: Antarctica, geoheritage inventory, geoconservation, GIS

Only 3‰ of Antarctica (44,000 km^2) is free from ice; however, the continent attracts over 100,000 tourists and about 4,000 scientific and technical staff. Such a high number of visitors, which is also continuously increasing, represents intense human activity and profound impact on the natural heritage. While there are comprehensive inventories created for the continent's biological and ecological components, geological heritage elements have not received the same level of attention until recent years. Nonetheless, rare rocks, minerals, meteorites, and fossils are at risk from unapproved collection or oversampling by both tourists and researchers on the continent. Identification and conservation of geological heritage features in Antarctica are relatively scarce because of the continent's geographical location, its ice coverage, and the extreme climatic conditions. In this regard, the only key initiative aimed at recognizing geological heritage elements on the continent was launched by the Scientific Committee on Antarctic Research (SCAR) in 2018. Nevertheless, this initiative has yet to result in a published systematic inventory.

The purpose of our initiative, referred to as 'Antarctic GeoHeritage Digital Inventory', is to create a comprehensive list of geological, paleontological, and geomorphological features that can be identified or proposed as geological heritage according to international standards. In this context, thorough information on potential geological heritage elements will be compiled and catalogued by reviewing published research on the continent, engaging in direct communication with researchers, explorers, visitors, as well as relevant personnel from museums, research institutions, and collections that display Antarctic specimens. The collected data is being organized into a geospatial database that will be shared with the international scientific community. This inventory aims to aid in the conservation of geological heritage in Antarctica.

FROM GEOLOGICAL RISKS TO RESILIENCE AND SUSTAINABLE DEVELOPMENT: THE STRATEGIC ROLE OF GEOPARKS

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Keywords: SDGs, hazard awareness, natural disaster, Türkiye, Black Sea Region

Awareness of natural disasters is essential for building resilient communities and achieving sustainable development goals. An informed and prepared society helps reduce loss of life and property, making disaster education a vital part of effective risk management.

Türkiye is highly vulnerable to natural disasters due to its geographical location. Earthquakes, floods, landslides, and wildfires frequently affect various regions. According to AFAD (Disaster and Emergency Management Authority of Türkiye), Türkiye experiences at least one earthquake of magnitude 5 or higher annually and ranks among the top countries for earthquake-related casualties. International reports like the World Risk Report also place Türkiye among the most disaster-prone countries.

The Black Sea Region in northern Türkiye is one of the areas with high disaster risk due to its geological structure and topographic features. The region has a complex geological feature with various tectonic units. The North Anatolian Fault Zone, one of the most active fault zones in Türkiye and the world, passes south of the region, increasing its earthquake risk. Additionally, the rugged terrain and high rainfall facilitate the occurrence and frequency of floods and landslides. This makes the Black Sea Region highly vulnerable to multiple types of natural disasters.

While the region's geological diversity increases hazard risks, it also provides important opportunities to raise local disaster awareness. In this context, geopark projects in the Black Sea Region hold great significance. The National Zonguldak Coal Geopark and Kastamonu Southern Black Sea Geopark Project enhance the region's tourism potential and host educational activities aimed at increasing disaster awareness. These areas function as open-air laboratories where geological feature and processes can be observed, supporting scientific research and community education.

Expanding geopark initiatives in geologically active regions, like the Black Sea, not only promotes local development, but also enhances disaster resilience. Such projects serve as strategic tools for educating communities, reducing national disaster risks, and advancing sustainable development.

GEODIVERSITY OF ILINČICA AREA IN THE TUZLA BASIN, BOSNIA AND HERZEGOVINA

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Keywords: geological diversity, education, protected landscape, geotourism

The investigated Ilinčica area belongs to Tuzla Basin that is situated in the northeast part of Bosnia and Herzegovina. The goal of this work is protecting geological diversity and rising public awareness on the importance of geodiversity and its use for geotourism purposes. Methods applied are analyses of accessible pre-existing literature and field work (Čičić et al., 1988; ProGEO-SARAJEVO 2006).

The area of Ilinčica displays many geological sites with educational, scientific and geoturistic potential. It is particulary interesting for students of natural sciences, such as geology, biology and geography. The natural landscape of Ilinčica is characterised by various geological features like sedimentary rocks and paleontological, structural, stratigraphic and geomorphological sites. Sedimentary rocks are sandstones, marls, conglomerates, limestones and clays. Paleontological sites with macrofossils and microfossils (Vrabac & Ferhatbegović, 2004) are evidence of marine and freshwater ecosystems that existed 12 million years ago during the Neogene. Also, there are many sites with secondary structures and stratigraphic elements.

The investigated area is a nearby hill Ilinčica with the highest peak of 452 m. It is easily accessible, 2 km away from the centre of Tuzla. It is the most attractive and oldest popular picnic place in the southern part of Tuzla. The area has touristic infrastructure and is suitable for leisure activities, such as walking, running and cycling. It is on the list of potential areas for legal protection. The Tuzla basin is very interesting from a geological point of view. It has three types of resources which are formed in unique ways: salt, coal and oil. The Ilinčica area has significant variety of geological phenomena for the establishment of a Protected Landscape.

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CULTURAL GEOLOGY AND MINING HERITAGE: ANCIENT UNDERGROUND NATURAL STONE QUARRY OPERATIONS IN HARRAN, ŞANLIURFA, SOUTHEASTERN TÜRKİYE

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Keywords: JEMİRKO, geoheritage, Anatolia, limestones, Gaziantep Formation, flint

The Harran region is a limestone platform facing the Arabian Plate. The Harran plain is geomorphologically a polje. The Middle Late Eocene-Oligocene limestones in this region were exploited as quarries and provided shelter from both heat and cold. Following the end of the Ice Age, around 12,000 years ago, *Homo sapiens* established settlements in the Harran region of Southeastern Anatolia and succeeded in cultivating wheat. Natural stone was first used for defence, shelter, grain grinding, and water retention purposes.

While over a thousand ancient stone quarries have been identified across Turkey, one of the earliest examples is found at Göbeklitepe in Şanlıurfa. In the Tek Tek Mountains, located 17 kilometers southeast of Harran, underground natural stone mining activities were carried out in the Bazda Caves (Bazda Ancient Marble Quarries), dated to around 6500 BCE. These quarries were officially designated as a 1st Degree Archaeological Site in 2010 and were included in the geoheritage inventory of JEMİRKO (the Turkish Association for the Conservation of the Geological Heritage). Harran is also included in the World Heritage Tentative list of UNESCO as historical, archaeological, architectural and scientific heritage.

In the Bazda underground quarries, galleries stretching hundreds of meters were excavated using the "room and pillar" technique in stylolitic and nummulitic limestones of the Eocene-Oligocene-aged Gaziantep Formation. The stone blocks produced here were later used in numerous historical structures throughout Harran and Şanlıurfa.

In this region, the limestones are intercalated by basalt flows from Karacadağ shield volcano, and the carvings were shaped using flint extracted from the limestone. The high ceilings (up to 25 meters) and multi-level underground structures reflect an advanced understanding of engineering. Chimneys (shafts) were created for ventilation and lighting. Tool marks, support pillars and ventilation systems, all point to a sophisticated level of ancient mining expertise. Within the quarries, carved stone hooks, inscriptions, and symbols are present, though some have deteriorated over time. Partial collapses have occurred in the Bazda quarries due to earthquakes and natural erosion.

Bazda stands out as a significant site meeting UNESCO criterion as both a geological and cultural heritage location. To ensure its preservation, restoration, structural reinforcement, and sustainable tourism, initiatives are urgently required. Through archaeometric analyses, the characteristics and ages of the tools and materials used can be identified, potentially offering new insights into the history of ancient mining worldwide.

DESTRUCTION RISK AS A LIMITING FACTOR IN THE GEOHERITAGE VALUE OF GYPSUM LANDSCAPE

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Keywords: gypsum karst, gypsum tumuli, hydration landscape, geosite assessment

The integrity of evaporite-related karst landforms is increasingly threatened by both natural and anthropogenic processes. Given their solubility, structural fragility, and sensitivity to surface disturbance, assessing the risk of destruction is essential when evaluating their geoheritage potential.

Numerous sites illustrate this vulnerability: in the Sorbas Basin (Spain), trampling and infrastructure have accelerated erosion; in the Ripon area (UK), subsidence related to gypsum dissolution poses significant hazards; and in the Vena del Gesso Romagnola (Italy), quarrying and tourism have visibly transformed surface features. Despite their high scientific, educational, and aesthetic value, such sites often suffer from insufficient protection and long-term monitoring.

By contrast, some abandoned gypsum quarries have been successfully repurposed as geotourism trails that promote geological awareness. For example, the former Kings Gypsum quarry in Hillsborough (Canada) features an interpretive path that highlights gypsum karst and mining heritage. Similarly, the Gipspfad Mehholz in Germany leads visitors through natural and anthropogenically shaped gypsum outcrops. Unfortunately, in other locations such as the Pisky quarry (Ukraine), I have personally witnessed the degradation of a unique hydration landscape due to inadequate measures.

My research focuses on the dynamics of gypsum-related landforms across several regions, including Spain, Canada, Germany, and Ukraine. In particular, Mediterranean gypsum tumuli, often located within protected areas, remain under threat from nearby quarrying. On the other hand, active anhydrite hydration domes have been observed developing on exposed anhydrite-rich surfaces following the removal of overlying gypsum layers. Ongoing and planned studies in Sicily, Emilia-Romagna, and Cyprus further would expand our understanding of these fragile features.

A notable finding is the dual role of human activity: while it may accelerate the degradation of gypsum tumuli, it can also facilitate the formation of hydration domes. For instance, tumuli have emerged on the floors of abandoned Miocene gypsum quarries in Poland and Ukraine, illustrating the complex interaction between hydrochemical processes and anthropogenic landscape modification.

We argue that dynamic monitoring tools and consistent geomorphological classification are essential for determining the geosite status of such evolving features. This study contributes to global discussions on conserving evaporite karst landscapes and highlights the need of geoheritage assessment.

ZONGULDAK COAL GEOPARK (TÜRKİYE) AND SOME OF ITS SIGNIFICANT GEOSITES

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Keywords: İstanbul zone, Palaeozioc rocks, Hard coal, Soğanlı cave, Calcholitic settlement, Egg rocks

The national and aspiring Zonguldak Coal Geopark is located in northwestern Anatolia, along the coast of the Black Sea. Geologically, it lies within the Pontide tectonic belt and is composed of rocks belonging to the "Istanbul-Zonguldak Zone," which features a distinctive rock succession from Lower Paleozoic to Paleogene. The most notable characteristic of this zone is the presence of hard coal (anthracite).

The Paleozoic units in the area have undergone low-grade metamorphism, with clastic sediments dominating the lower sections and carbonates more prevalent in the upper levels. During the Mesozoic era, carbonates were deposited, followed by deep marine clastics with volcanic inputs.

Within the geopark, 50 primary and 59 potential geosites have been identified. They cover a large group of geological heritage categories, from stratigraphic and tectonic to geomorphological and cultural geosites, apart from a large variety of natural assets. Numerous deep canyons and caves are usual features and among these, the Soğanlı Cave holds reference formations for understanding the Late Pleistocene–Holocene climatic changes in the Caucasus and the Middle East.

Landslides represent another characteristic feature of the region. One of the cultural geosites is İnönü Cave, which contains rich archaeological findings from the Chalcolithic period. Another notable geosite that attracts interest from non-geologists is a group of spherical rock formations popularly known as “egg rocks.” They lie at depths of 10 to 25 meters below the surface. While most eggs range between 60 and 80 cm, the largest measures 4 metres in diameter. Although at first glance they resemble products of spherical exfoliation, they are located entirely underground and are not visible at the surface.

Here, we present some geosites of international significance and discusses their geological formations, with particular emphasis on hard coal and egg rocks.

GEOMYTHOLOGY IN TÜRKİYE; A STABLE BRIDGE BETWEEN GEOSCIENCES AND SOCIAL SCIENCES

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Keywords: Geomythosite, Noah Arc, Trojan War, cultural geology, types of Geomythosites

Geomythology is the exploration of ancient myths and legends to gain insights into past geological events (Vitaliano, 1973). Geomythosites are classified into four main categories based on their attributes: religious, historical, folkloric, and popular (Kazancı, N & Boyraz-Aslan, 2025. Well-known historical examples include Noah's Ark and the Great Flood, the Camels of Nimrod, the eternal flame of Mount Olympos, and the Trojan War. Religious sites like Balıklıgöl in Urfa, the Cave of the Seven Sleepers (Ashab al-Kahf), and the House of the Virgin Mary continue to serve as significant spiritual centres today. Geomythosites hold great potential as guides for both geoscience education and the protection of geological heritage. Here we introduce some examples of geomythosites in Türkiye.

The archaeological sites of Göbeklitepe, dating back 12,000 years, and Çatalhöyük, one of the first Neolithic cities, reveal that the Middle East and Anatolia have been centres of human settlement since the earliest periods of history, hosting numerous civilizations. The primary reason for the preference of Anatolia and the Middle East as settlement areas lies in their abundant rivers, lakes, seas, plains, and mountains—in other words, their exceptional geological and consequent biological diversity. Anatolia is a tectonic collision zone and serves as a geological bridge connecting continents. This unique setting has led not only to a richness of geosites but also to a proliferation of geomythological elements. From the Code of Hammurabi to the tales of One Thousand and One Nights, and from the mythic Mount Qaf to the legendary Phoenix, the region is rich in mythological narratives. Frequent natural events in Anatolia, such as earthquakes, volcanic eruptions, and droughts, have contributed to the abundance of myths and epics.

Despite the public's strong interest in mythological stories today, there is relatively little awareness or appreciation for geological heritage. Geomythosites—sites that embody both geological and mythological significance—can serve as an effective bridge between the social sciences and geosciences and play a key role in the preservation of geological heritage. To this end, JEMİRKO – the Turkish ProGEO has initiated an inventory project for identifying and cataloguing geomythosites. For a location to be officially recognized as a "geomythosite," it must be associated with a written mythological narrative and must also be registered as a geosite. Otherwise, nearly every location in Anatolia might be indiscriminately considered a geomythosite.

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ASPIRING SAMCHEOK GEOPARK IN KOREA

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Keywords: Geodiversity, Sustainable Development, Geo-education, Lower Paleozoic Sedimentary Sequence, Karst Landforms

Promising and aspiring Samcheok Geopark in Korea shows high geological diversity including Precambrian metamorphic rocks of sedimentary and igneous origins, Cambrian to Ordovician marine sedimentary rocks, Carboniferous to Permian, marine to nonmarine sedimentary rocks, Cretaceous volcanic and plutonic rocks (rhyolite and granite), Cretaceous pyroclastic rocks (tuff), Cretaceous terrestrial clastic rocks of alluvial to fluvial origin, and Miocene lacustrine sedimentary rocks with plant and insect fossils. Also, Quaternary travertine formed by limestone karst springs and various cave features can be included. High mountain range in the west, coastal erosional and/or depositional landforms along the eastern coast of the central Korean Peninsula, and various karst landforms with caves of different genetic processes provide high geomorphic diversity. Among them, significant geo-heritage values of some limestone caves and the Lower Paleozoic sedimentary sequence in Seokgaejae area provide the justification to be endorsed as a National Geopark, and probably as a Global Geopark. This high geodiversity may well provide effective geo-tourism for public geo-education. Twelve geosites (Baekdu-daegan Daetjae Mountain Range, Jukseoru Fluvial Landforms, Deokbongsan Coastal Depositional Landform, Chogok Coastal Erosional Landforms, Jangho Coastal Ecosystem linked with geodiversity, Chodang Cave and Sohan Valley, Daeiri Cave Area, Mugeonri Moss Waterfall, Miin Waterfall and Tongri Gorge, Gagok Hot Spring, Deokpung Valley, Seokgaejae Sedimentary Sequence and Cave) are nominated, based on geo-heritage values and their high potential for educational tourism and local sustainable development. Also included in the geopark are future potential geosites which may well increase geodiversity of the geopark. They are limestone caves (Hwalgi Cave, Anjeongsan Cave), Mt. Yongamsan Tuff Deposits & Landform, Mt. Swinumsan Granite Panholes (gnamma holes), Dogye Coal Mine, Seongnamdong Karst Landforms, Ichoen Waterfall, Sangbancheonri Yongsogul Travertine, Sinnam Complex Coastal Landform, Osipcheon River developed along the Osipcheon Fault, etc. Especially various and abundant, ecological, historical, cultural, and archaeological tour resources nearby every geosite would make a strong candidate for an ideal geopark in Korea.

THE GUTÂI-MARAMUREȘ PROJECT, A NEW INITIATIVE FOR A UNESCO GEOPARK IN NW ROMANIA

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Keywords: geoheritage, volcanism, mining heritage, geoeducation, geotourism

The Gutâi-Maramureș UNESCO Global Geopark project is intended to be realized in the Gutâi Volcanic Zone in the East Carpathians (NW Romania), an area with a long-lasting and complex Miocene volcanic activity (15.4-7.0 Ma) and seven centuries-long precious and base metals mining history. The development of the project recently started in the framework of a partnership between the Maramureș County Council, the University of Bucharest, the "Victor Gorduza" County Museum of Mineralogy in Baia Mare and the NGO "Association for Tourism Promotion and Sustainable Development" in Baia Mare. The territory of the future geopark was established based on a SWOT analysis and includes five towns and eight communes located in the surrounding area of the volcanic zone, and the most important patrimonial assets of geological, mining, natural and cultural heritage. The first steps taken in the project addressed the full inventory of all patrimonial values which will constitute supporting elements in the assessment for accreditation as a UNESCO Geopark. The geoheritage of the area includes numerous geosites of international scientific significance related to the volcanic area, in which, the most important geological patrimonial value is represented by the mineralogical heritage, with 10 minerals described here for the first time in the world, including the Mineralogical Museum ex-situ geosite. Numerous sites with old mining works and buildings such as the ex-situ site History and Archaelogy Museum form a valuable mining heritage, related to the continuous mining activity in the area exceeding 700 years. The natural heritage of the future geopark includes 21 natural protected areas at national level, as well as 6 Natura 2000 sites, one of which beeing a UNESCO World Heritage Site. The rich cultural heritage consists of numerous cultural objectives of great patrimonial value (172 historical monuments recognized at national and international level, 5 included in the UNESCO World Heritage List). The Gutâi-Maramureș UNESCO Geopark project aims at harnessing the unique combination of geological, mining, natural and cultural heritage values of the area by the implementation of the geoeducation, geoconservation and geotourism concepts during the project development, based on previous experiences in the area involving local people, NGOs and institutions.

MONS MEDIUS (MINE HILL) – BAIA SPRIE, AN OUTSTANDING GEOHERITAGE SITE IN THE MIOCENE GUTÂI VOLCANIC ZONE (NW ROMANIA)

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Keywords: geosite, mining history, minerals, Blue Lake, Mining Park

Located north of Baia Sprie town, on the southern edge of the Gutâi volcanic mountains (NW Romania), Mons Medius (Mine Hill) represents the uppermost part of the Baia Sprie hydrothermal ore deposit. Characterized by valuable features of geological, mining and touristic interest, Mons Medius represents an exquisite geosite that stands out through an impressive series of superlatives. It hosts the longest hydrothermal vein in Europe (> 5 km), being one of the oldest exploited (since 1329), earliest described and most studied ore deposits in Europe (more than 100 scientific papers published since 1774). It is the only vein-type epithermal ore deposit in Romania developed in an E-W trending graben structure related to a major tectonic system. Deepest (> 900 m) in the region, the ore deposit presents the most typical vertical compositional zoning (Au-Ag in the upper, Pb-Zn in the middle and Cu in the deeper parts) and associated hydrothermal alteration. Mons Medius is the type locality for 6 newly discovered minerals (andorit, semseyit, felsőbányait, dietrichit, klebelsbergit, szmikit) among the more than100 identified in the deposit (first described in 1854). The site includes the "Blue Lake", an anthropogenic lake formed by collapse of an old mining work, unique in Europe by its peculiar ore-determined water color (III IUCN site). Mons Medius hosts many old mining works, remnants of more than seven centuries of mining activity. It is the most visited geosite in the Gutâi Volcanic Zone for scientific (field trips of international geological conferences), educational (summer practice of Geology students), and touristic (mostly visiting the amazing Blue Lake) purposes having the highest total score in the quantitative assessment (Brilha methodology) of the region's geosites. It also hosts the only Mining Park in Romania, recently inaugurated, with thematic routes including old mining works, the Blue Lake and landscape-looking viewpoints. Displaying a number of unique features of high patrimonial value in the domains of geology/mineralogy and mining history, Mons Medius can be considered the most valuable geosite in the new UNESCO Geopark project initiative currently developed in the region.

SANDSTONE GEOHERITAGE: A CASE STUDY FROM CHŘIBY MOUNTAINS (MORAVIAN CARPATHIANS, CZECH REPUBLIC)

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Keywords: geosite, geoconservation, threats to geodiversity, risk assessment, cultural heritage

The territory of the Czech Republic shows many diverse examples of crags and tors, especially in sandstone areas. However, while the Bohemian Cretaceous areas have already been examined in detail, the sandstone crags in Moravian Flysch Carpathians have been given only limited attention (Kubalikova et al., 2025b). This contribution is focused on the sandstone crags in the Chřiby Mountains being explored from the following perspectives: identification of the crags as geoheritage elements (including their geocultural values) and their assessment in terms of threats and degradation risk. The application of semi-quantitative assessment methods (degradation risk evaluation and Risk Assessment Matrix) enabled the ranking of the sites according to the degree of possible deterioration and helped to identify particular threats, which can be considered important when planning and managing the area's natural resources (Kubalikova et al., 2025a). The recognition of geoheritage values of sandstone crags, along with identifying and evaluating risks and threats, may serve as a basis for effective management and further research.

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THE HISTORY OF DEŞLI CAIRA SECTION AS GSSP CANDIDATE

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Keywords: Middle Triassic, Global Boundary Stratotype Section and Point, ammonoids

The Triassic successions of the Tulcea Unit, part of the North Dobrogea Orogen, are well known in the classic geological literature for the richness of their fossil faunas containing ammonoids, nautiloids, bivalves, brachiopods, conodonts, foraminifera, ostracods and marine vertebrates. The most important and well exposed Triassic sequences of the Tulcea Unit are known from Agighiol and Deşli Caira sections which are famous especially for the ammonoid faunas which have been first described in classic monographs by Kittl (1908) and Simionescu (1910). Eugen Grădinaru (1942-2025), former professor at the University of Bucharest, devoted most of his professional life collecting ammonoids from all the Triassic sites from North Dobrogea, but especially from Deşli Caira. Several specialists were involved in the study of paleontology and stratigraphy of this locality and co-authored the preliminary proposal of Deşli Caira as candidate for the GSSP of the Anisian base (Grădinaru et al., 2007). However, the taxonomic description of the ammonoid faunas was never been published by Prof. Grădinaru. 833 ammonoid specimens from Deşli Caira section, with reference to bed/sample number have been found and numbered and registered by us in the official collection of the University of Bucharest. The impressive work carried out by Eugen Grădinaru would have likely been lost if Spencer Lucas, chairman of the Olenekian/Anisian boundary Working Group (Subcommission on Triassic Stratigraphy) had not intervened in the Spring of 2023 and invited us to resume Grădinaru's work. Therefore, Balini et al. (2024) published the first paper with the systematic descriptions of the Anisian taxa among which two new taxa: *Gradinaruites aegeicus* Balini and Lăcătuş, 2024 and *Robinsonites simionescui* Balini and Lăcătuş, 2024. Correlations of the ammonoid record of the Deşli Caira section with other candidate sections Kcira (Albania) and Chios (Greece), demonstrate that the ammonoid record of Deşli Caira is the most complete, therefore this section is crucial for the calibration of the other Tethyan sections. Deşli Caira section provides the best record of the Olenekian/Anisian Ammonoid Faunal Turnover event, one of the major events in the Triassic history of Ammonoidea, and allows also the best calibration of the magnetochrons MT1-MT3, this combination representing a powerful solution for the definition of the GSSP of the Anisian base. All these aspects increase the Geological Heritage value of Deşli Caira section, which represents one of the unique geological key-points of the UNESCO Cimmerian Dobrogea Geopark project.

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STONE PROVENANCE IN THE WALLS OF NOVIODUNUM FORTRESS

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Keywords: lithic material, quarry, outcrop, Northern Dobrogea, Roman-Byzantine era

The Noviodunum Fortress, located approximately 2 km east of Isaccea Town, Tulcea County, was for several centuries an important military, economic and cultural center. Over time, it came under the control of the Romans, followed by the Byzantines, and even under Mongol hordes (Stănică, 2015). As a strategic point on the Danube, Noviodunum was connected through a well organised road network (Panaite, 2016) with other important Dobrogean settlements. Thanks to this efficient logistics by land and water, the transport of lithic material from the extraction areas to Noviodunum was carried out with ease.

Dobrogea has the advantage of being rich in geological outcrops, especially in its northern region, where limestone and, to some extent, sandstone are well developed. These kinds of rocks were preferred by ancient builders because they are easy to shape and transport, while the harder and heavier stones were used only casually.

In this study, based on the stone fragments from the Noviodunum walls, we attempted to reconstruct the provenance areas of the lithic material. Unfortunately, the Noviodunum walls were partly demolished by the Ottoman rulers for the construction of their fortifications, as well as by the locals for civil structures, like residential houses or paved roads (Drăghicescu, 1943; Stănică & Dinu, 2017). Some remains, mainly in the southeastern part of the fortress, are still visible, and those were the object of our investigation.

Our observations pointed out that most of the stone used for the construction of the fortress walls comes from Northern Dobrogea. However, a few fragments seem to originate from more distant areas, such as the Babadag Plateau or Southern Dobrogea.

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GALLOPING GUIDELINES FOR INTERPRETATION – IN ?15 MINUTES + 5

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Keywords: geoheritage, communication, jargon, wordswordswords, 'normal' people

Others have said that much of the material produced for the public – 'normal people' – in geoparks and at many other heritage sites is inappropriate. For example, Roger Crofts presented a poster on this at the ProGEO Conference in 2023, followed by a paper (Crofts, 2024). Some geopark evaluators have (privately!) said the same.

Guidelines were produced by Macadam (2018) in Reynard & Brilha's Geoheritage book. An expanded second edition has been published in 2025 with an expanded chapter on interpretation, now running to 13k words (Macadam, 2025).

Štrba & Palgutová (2024) based their analysis of panels submitted by UNESCO Global Geoparks in Europe on criteria mostly extracted from the 2018 chapter. Many geoparks did not respond to the request.

Reynard & Brilha's book is widely seen as the 'bible' on geoheritage. After initially being trained in interpretation, on a Royal Society award, by the US National Park Service in 1999, the author has worked with geological surveys in Norway, Finland, Poland, and Brazil, and geoparks in many countries, as well as teaching on academic courses in universities in UK, Italy, Portugal, Morocco, and Brazil. And probably others! Many people have offered comments on the original chapter and many of these have been incorporated in the revised, enlarged chapter which now includes a very short 'menu' the author uses when commissioned for an interpretation project. This talk will present an even shorter menu, but the chapter is available as a pdf, on request.

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USING INTERPRETATION TO REDUCE THEFT OF DINOSAURS' FOOTPRINTS?

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Keywords: geoheritage, protection, management, communication, SSSI

Bendrick Rock on the Welsh coast has been described as the best dinosaur trackway site in the UK. But the theft of individual footprints has been a longstanding and recurrent problem for those who wish to protect the site, which has full statutory protection as a SSSI (Site of Special Scientific Interest). Potential prosecution has not deterred potential thieves. The site is owned by BIGC (British Institute for Geological Conservation).

The statutory conservation body in Wales, Cyfoeth Naturiol Cymru / Natural Resources Wales (NRW), offered to pay for an information board at the site, and the author was invited by Professor Mike Benton, the Chairman of BIGC, to work on this, pro bono, with the production costs being paid by NRW.

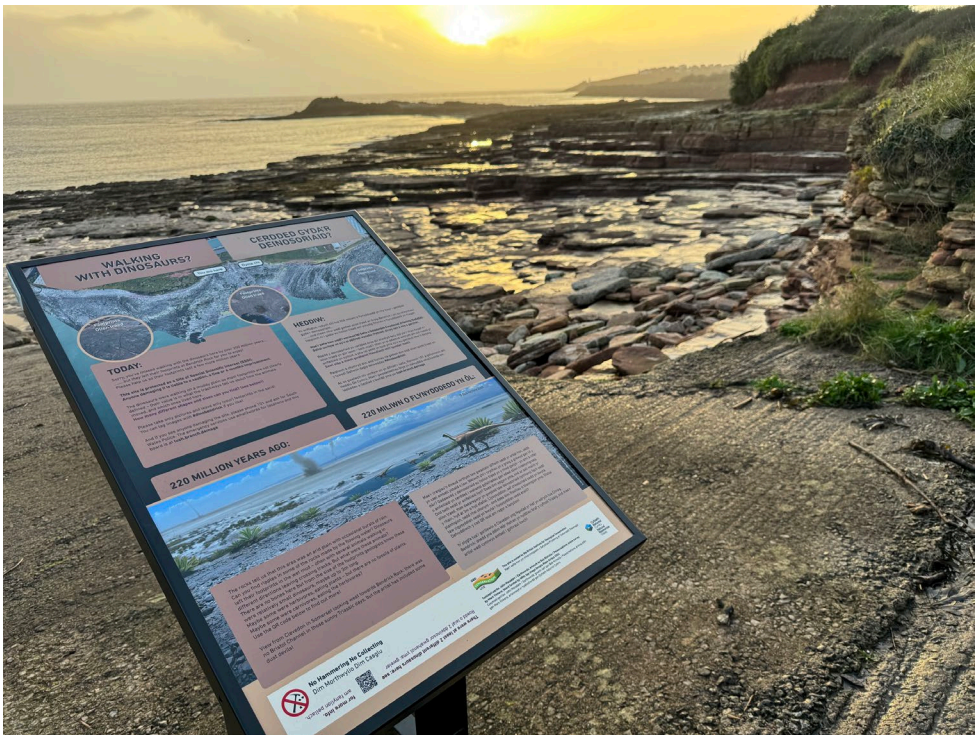

Fig. 1. The board at Bendrick ©Ben Evans

The decision was made to use Freeman Tilden's "mantra" "Provoke, Relate, Reveal", as the guiding principle (Macadam, 2018). "Walking with dinosaurs" was a popular BBC series in 1998, and is currently being shown again in an updated form. The title of the board is "Walking with dinosaurs?" and the text begins by apologising that the visitor has missed the dinosaurs by a few years, but they left their footprints to be enjoyed. And please leave them for others to enjoy. And if you don't – and you damage

or steal them – there are legal consequences, including large fines. The board also includes an image of the whole site from a drone survey to show visitors that changes will be noted (Fig. 1).

The board then continues with a reconstruction by Bob Nicholls of a similar site on the other (south) side of the Bristol Channel (which did not exist in Late Triassic times). It also includes a small amount of descriptive text, plus a QR code linking further text on BIGC's website (www.geoconservationlive.org).

A text draft, with illustrations inserted, was displayed at the 2023 ProGEO conference, inviting comments.

Shortly after installation, the board was removed by a large storm, but has been found, restored and replaced.

There has not been enough time to see if the board really does eliminate – or even reduces – theft.

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COMPARATIVE STUDY TO REVEAL THE TOURIST AND SOCIO-EDUCATIONAL POTENTIAL OF FOUR PROPOSED SITES IN CONSTANȚA COUNTY, SE ROMANIA

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Keywords: Geotouristm potential, Rasova, Șipotele, Limanu, Sibioara

Constanța County is a geographically, historically, and economically significant region in southeastern Romania with a rich, but largely unexploited geological heritage, that needs thorough technical and scientific research. In the last few years, we published a database about the geological sites in Constanţa County (Grigore et al., 2022).

Here, we present four proposed geosites that show geotouristic potential. The first is a relatively recent outcrop near Rasova of Lower Cretaceous strata (with fossils) suitable for educational purposes. Next is a small abandoned quarry near the village Șipotele, a site with an impressive fossiliferous association from the Lower Cenomanian (Peștera Formation) and Sarmatian (Cotu Văii Formation). Limanu is an interesting fossiliferous site that can be used to illustrate and research the Sarmatian paleoenvironment. Finally, yet important is the Sibioara old quarry, an impressive opening of the Histria Formation (Ediacaran).

We applied the Geosite Evaluation Model (Vujičić et al., 2011) to evaluate and compare geosites. We projected them into the displayed matrix, and they fitted into the Z21 field, which indicates a moderate level of Main Values and a low level of Additional Values. Maximizing the potential of these sites requires an integrated strategic approach. Encouraging a public-private partnership and interdisciplinary research can lead to sustainable exploitation (tourism/geotourism, educational) and fill infrastructure gaps. We strive to promote a holistic understanding of the natural and cultural assets of Constanţa County to realize its full heritage potential.

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RISK MANAGEMENT IN GEOHERITAGE CONSERVATION

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Keywords: immovable and movable geoheritage, assessment, factors

Geoconservation combines a set of actions focusing on protecting, conserving, presenting and promoting the geodiversity and geoheritage for their intrinsic, ecological and heritage values. Beside the preventive protection, geoconservation also includes development and improvement in the field of scientific and professional research, legislation, education, spatial and urban planning and tourism.

Geoheritage can be grouped into immovable and movable (Maran, 2010). Immovable (*in situ*) geoheritage refers to the areas or localities with clearly pronounced geological, geomorphological and pedological characteristics (outcrops of igneous, metamorphic and sedimentary rocks, ore and fossil-bearing deposits, surface and underground landforms, structural and tectonic forms, hydrogeological phenomena, types of soil). Movable (*ex situ*) geoheritage objects are representative specimens of minerals, rocks and ores, fossilized remains of plants and animals and traces of their life activity that are kept in museums and other institutions or in private collections.

Risk factors differ for immovable and movable geoheritage objects. To successfully manage the risks, it is necessary to assess the current condition of the sites/objects, identify factors that undermine or compromise their integrity, plan activities and financial resources, and choose appropriate measures and solutions in order to prevent potential risks or remedy the existing ones (Maran Stevanović, 2018). Risk factors affecting the degradation of geosites can be natural and anthropogenic.

The natural degradation is usually caused by weathering and erosion processes, the occurrence of landslides and vegetation growth. Human activities contribute to faster degradation of geosites, including expansive spreading of urban areas, overexploitation, improper waste disposal and unplanned and unprofessional collection of geological materials.

Risk assessment in the moveable geoheritage (*ex situ*) consists of identifying and recording all the factors (external and internal) that threaten geological collections in order to avoid, prevent or eliminate their effects.

External risks are objective factors from the external environment that generally cannot be influenced (existing political, social or economic environments, unpredictable natural processes). Internal factors are the potentials or limitations within the institution in which the items and collections are kept; they include the presence or absence of appropriate organizational structure, professional staff, financial resources, program activities and information technologies.

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USING INTANGIBLE HERITAGE AND VERNACULAR DESIGN IN THE FORMATION OF NEW GEOCONSERVATION PRACTICES: LESSONS FROM CHARNWOOD FOREST GEOPARK

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Keywords: Palaeontology, Management, Geopark, Interpretation, Geoconservation, Access

The geoconservation of palaeontological geosites remains a complex endeavour, with a site's natural characteristics and risk profile often necessitating a unique management plan. In addition, the underrepresented status of geodiversity within landscape management can be a barrier when obtaining support, funding, and permissions for geoconservation interventions – further hampering progress in the protection of geoheritage.

The Ediacaran sedimentary succession of Charnwood Forest contains some of the oldest animal fossils in the world. The conservation and management of this internationally significant palaeontological heritage have been an ongoing challenge, with the need to balance protection, research, public access, and site aesthetics. The global black-market trade in Precambrian fossils requires that the location of fossil geosites remain unpublicised, therefore preventing the use of signage to alert visitors to the importance of the site and the need not to damage the rocks. However, by being unaware of the significance of the site, well-meaning visitors climb upon the fossil surfaces, unwittingly degrading the fossils. An intervention was therefore necessary, but with careful planning that didn't reveal the fossil site's location, and that respected the landscape character and other heritage significance within the area.

This presentation will outline how Charnwood Forest Geopark and partner organisations have collaborated to design and implement a bespoke fossil protection solution that utilises the traditional construction style of drystone walling. By using an architectural style that is long established within the landscape, visitors were dissuaded from visiting the fossil site. The presentation will further outline the complexities of obtaining permissions for geoconservation interventions, and how the use of generic conservation language can be used to the benefit of geodiversity protection. Furthermore, examples will be provided of how high-quality fossil interpretation can be provided without the need for geosites to be visited. These examples from Charnwood Forest Geopark are a valuable case study in how to protect and interpret geoheritage where a geosite is not suitable for visitation by the general public.

PERIGLACIAL LANDFORMS UNDER FOREST – CONSERVATION AND INTERPRETATION CHALLENGES

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Keywords: blockfields, tors, Pleistocene, protected areas

Relict cold-climate (periglacial) landforms, deposits and structures are abundant in Central Europe and serve as important carriers of information about past environments and climate change during the Quaternary. Thus, they constitute an important part of regional geoheritage. Among them are rock landforms such as crags, cliffs, angular talus and, above all, blockfields. They are associated with depositional landforms represented by solifluction sheets and tongues, which may show distinctive geomorphological signatures. In open terrains such as uplands of south-west England or parts of the highlands located above the timberline, these periglacial landforms are well visible and accessible, facilitating their interpretation in terms of geoheritage. However, in forested areas they are largely concealed by vegetation and their spatial relationships are less obvious, especially to the casual observer. In this presentation I will focus on two bedrock elevations from south-west Poland, which host impressive suites of cold-climate landforms and deposits, however hidden by forest. One, Mount Ślęża, is a gabbro inselberg with large tors, extensive blockfields and enigmatic mass movement landforms. Another one, Muchowskie Wzgórza, located partly in the Land of Extinct Volcanoes UNESCO Global Geopark, is built of basalt and includes rock cliffs, crags, blockfields, and solifluction landforms. Both localities are reasonably well-documented in scientific literature (Migoń et al., 2020; Traczyk, 2014) but have been largely overlooked as geoheritage sites and are poorly known to the general public. An additional constraint is imposed by their presence within protected areas (nature reserves) established to provide protection to forest communities. By law, only waymarked trails can be used to explore these areas, whereas many specific localities of interest are away from the trails. Thus, they are technically inaccessible unless special permissions are obtained. One way to overcome these natural and legal constraints is to take advantage of modern technologies and use visualizations based on LiDAR imagery in the interpretation. New interpretative trails are another tool and an example of a recent project will be presented.

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MINING OF QUARRIES AND GEOLOGICAL HERITAGE – EXPERIENCE FROM LITHUANIA

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Keywords: quarries of raw materials, rehabilitation, geological heritage, Quaternary

The list of legally protected geological monuments of Lithuania contain: erratic boulders (over 100), outcrops of pre-Quaternary rocks and Quaternary deposits, springs, geomorphological objects (hills eskers, karstic sinkholes) (Satkunas et al. 2012).

Quaternary deposits formed during continental glaciations and ice-free intervals cover continuously the whole territory of Lithuania (Guobytė & Satkūnas, 2011). The pre-Quaternary rocks – starting with Devonian sediments, could be observed in a day light in few natural outcrops in river valleys Šventoji, Venta, Nemunėlis, Mūša and few others, or in artificial exposures made due to exploitation of Devonian dolomite (Petrašiūnai, Klovainiai, Skaistgiris), Permian limestone (Karpėnai), Triassic clay (Šaltiškiai) and Neogene quartz sand (Anykščiai).

The open quarries give unique possibilities to observe directly the structure of sedimentary cover and collect samples for geological and paleontological research. However, the mining of raw materials in quarries change landscape and after completion of mining the quarries must be rehabilitated and turned into water bodies or forested. In many cases, rehabilitated quarries became recreational sites and increase biodiversity. According to current regulation it is not allowed to leave open and steep walls and outcrops that could be used as geoheritage sites. However, there are few sites of historical mining where walls of dolomite section or blocs of conglomerates are proclaimed as geological monuments. We propose to analyze all possibilities to turn quarries into geoheritage sites by promoting best practices and improving legislation accordingly.

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SĂCĂRÂMB VILLAGE, A SITE OF GEOLOGICAL AND MINING INTEREST (METALIFERI MOUNTAINS, ROMANIA)

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Keywords: geoheritage, mining heritage, type locality, nature reserve, Apuseni Mountains

This work emphasizes the geological and mining heritage of the area of the Săcărâmb Village (Figure 1a) located in the Apuseni Mountains (Western Romania), namely in the south-eastern part of the Metaliferi Mountains. Săcărâmb is a historical mining locality, world-famous for the richness in precious minerals of the epithermal Au-Ag-tellurides ore deposit associated with magmatic rocks of Neogene age. Since the discovery of the deposit (in 1740s), the Săcărâmb mines have been in production for over 250 years (up to 2006). Săcărâmb is the *mineral-type locality* (minerals discovered for the first time in the world) for eight minerals. Here are the names, the chemical formulae and the year of discovery of each of these minerals: **alabandite** – MnS, **1832** (Figure 1b); **nagyágite** – $[Pb_3(Pb,Sb)_3S_6](Au,Te)_3$, **1845** (Figure 1c); **petzite** – Ag_3AuTe_2, **1845**; **krennerite** – Au_3AgTe_8, **1877**; **muthmannite** – $AuAgTe_2$, **1911**; **stützite** – $Ag_{5-x}Te_3$ (x = 0.24 – 0.36), **1951**, redefined in **1964**; **krautite** – $Mn(AsO_3OH)\cdot H_2O$, **1974**; **museumite** – $[Pb_2(Pb,Sb)_2S_8][(Te,Au)_2]$, **2003** (Milu, 2021). Over the years, more than 100 mineral species have been identified and described in the Săcărâmb area (e.g., Udubaşa et al., 1992; Dincă et al., 2025).

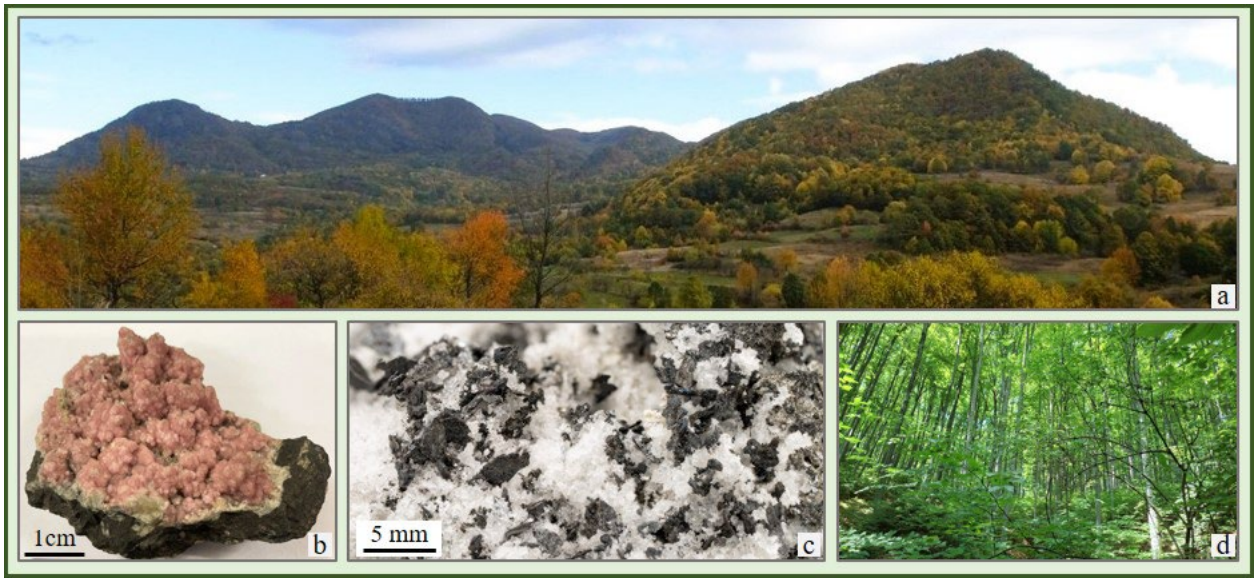

Figure 1. Photographs showing: a) Săcărâmb village area – view from the south; b) sample from Săcărâmb ore deposit – rhodocrosite rosettes in association with quartz crystallized on an alabandite matrix (Collection of the National Geology Museum; Bucharest, Romania); c) sample from Săcărâmb ore deposit – lamellar nagyágite crystalls associated with prismatic sylvanite crystals on a matrix of calcite and quartz; d) image taken in the Măgurile Săcărâmbului nature reserve.

It is to mention the Măgurile Săcărâmbului nature reserve of national interest (IUCN Category IV), located in the eastern part of the village. The area is also known under the name of Silver Forest, the name used by local people (due to the white colour of the bark of the *Fagus sylvatica*) (Figure 1d).

In addition to the geological and mining heritage value of the area of the Săcărâmb Village, it is to note its scientific value, highly significant on an international scale (Milu, 2021). Săcărâmb Village could be considered a site of geological and mining interest that could contribute to the promotion of geoheritage and mining heritage of the Metaliferi Mountains, and, by including it in a geoitinerary, to the promotion of geotourism in these mountains.

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THE DIGITAL GEOSITES MAP, A NECESSITY IN SUPPORT OF TOURISM

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Keywords: geoheritage, geotourism, geosite mapping, geoconservation, digital cartography

For more than two decades, geologists have focused their attention on issues related to geoconservation, geotourism, geoheritage, geotourism, etc. Concerns about these issues in general, and specifically about classification, concepts, and identification, have been the subject of many publications in the field of geoheritage (Seghedi et al., 2025).

Fossils, rocks, mineral deposits, or geomorphological features are an integral part of nature and therefore require the involvement of the entire community. Mapping may be considered a powerful means of communication, particularly effective because it uses an international language that is easily transmitted and difficult to misinterpret (Coratza & Regolini-Bissig, 2009). It is also a basic requirement for land use management, as effective protection of nature requires a clear delimitation of the involved sites. Additionally, mapping facilitates the transfer of information, provided it is presented in a comprehensible and accessible format (Fernández-Martínez & Fuertes Gutiérrez, 2012).

The Albanian Geological Survey has been involved in geoheritage issues and concerns since 1998. The first inventory of geosites in Albania (Serjani & Neziraj, 1995) laid the foundation for geo-conservation and geoheritage efforts in the country. A total of about 900 geosites were identified and mapped, each accompanied by descriptive text, graphics, or illustrative photographs. The geosites were classified and symbolized based on several main criteria: (1) origin of formation (7 groups); (2) level of importance (local, national, international); and (3) the values they represent (scientific, didactic, touristic, etc.). The geological map and its 3D model served as the background layer. Additional thematic maps are anticipated, including a risk map of geosites, geotourism maps, and geotour itineraries, all generated after the data are integrated into a GIS platform and geodatabase. This geosite mapping also provides input for delineating potential geopark boundaries by combining data with the national protected areas map published by NAPA. For the tourism sector, the map offers added value as part of the suite of geotourism and tourist maps. It enhances communication and accessibility, as geoheritage information visualized on a map is easier to interpret for both decision-makers and general users.

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SYNERGIES BETWEEN POTENTIAL KEY GEOHERITAGE AREAS (KGAs) AND KEY BIODIVERSITY AREAS (KBAs) IN SPAIN AND SCOTLAND: TOWARD A HOLISTIC NATURE CONSERVATION FRAMEWORK

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Keywords: Geoheritage; Geodiversity–biodiversity integration; Conservation planning; Spatial overlap analysis

This pilot study examines the spatial and inferred functional links between potential Key Geoheritage Areas (KGAs) and Key Biodiversity Areas (KBAs) in Spain and Scotland. In Spain, the area covered by potential KGAs is much smaller than that of KBAs, only 1.7%, but 78% of potential KGA areas overlap entirely with KBAs. This overlap suggests that designating KGAs will have a limited spatial impact but will offer significant opportunities for conserving both KGA and KBA values in a more integrated manner. Most potential KGAs in Spain are related to coastal and littoral deposits, but also include fluvial, aeolian, volcanic, karstic, and geological structural units influencing habitats and species distributions. In Scotland, all 40 globally important KBAs show inferred functional links with geoheritage, particularly coastal cliffs, freshwater hydrology, soils, and geomorphological processes that support seabird and goose habitats. In both areas, geomorphological interests predominate in shaping landscapes and ecological conditions critical to biodiversity. Overall, the Spanish and Scottish cases demonstrate that overlapping KGA and KBA designations would benefit from integrated conservation strategies to protect and promote the natural value of protected areas, especially in the face of climate change, sea-level rise and accelerating human impacts. Since KBAs in Spain and Scotland have not been identified for all taxonomic groups, it is likely that more overlaps and functional linkages will be apparent when the KBA dataset is updated in both countries and KGAs are formally assessed. Integrating geoconservation with biodiversity management will be requiring skilling of staff. These case studies demonstrate the inseparability of abiotic and biotic components of nature and support the case for more integrated and effective nature conservation worldwide.

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PRELIMINARY ASSESSMENT OF GEOHERITAGE SITES IN NORTHERN KASTAMONU (NW TÜRKİYE) AND THEIR GEOPARK POTENTIAL

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Keywords: Geopark, Geoheritage, Geotourism, Central Pontides

The project area, defined as the "Kastamonu Southern Black Sea Geopark," encompasses the districts of Pınarbaşı, Şenpazar, Azdavay, Ağlı, Küre, Cide, İnebolu, Bozkurt, Abana, and Çatalzeytin. Geologically, the region is situated within the Central Pontides, where the western part is characterized by the İstanbul Zone and the eastern part by the Sakarya Zone. The region's complex geological evolution, combined with the presence of the North Anatolian Fault Zone – a major tectonic feature of both Turkey and the world—has contributed to its rich geological diversity. Additionally, geological records related to the opening of the Black Sea can be observed in the field, further enhancing the area's scientific and educational value.

Key geoheritage features highlighted in the project include deep canyons, waterfalls, caves, coastal landforms, rugged mountainous terrain, fossiliferous outcrops, thick flysch sequences of varying ages, and various deformation structures related to tectonic movements. Furthermore, the Küre copper mine and processing site—one of the oldest mines in Anatolia—represents a significant industrial heritage asset. Moreover, prominent geotourism sites such as the Çatak, Valla, and Horma canyons, Ilıca Waterfall, and the coastal towns of Cide, İnebolu, and Abana actively attract visitors.

All these characteristics indicate that the region holds high potential for geopark designation and offers important opportunities for geoconservation, education, and sustainable tourism development.

PROMINENT GEOLOGICAL AND CULTURAL HERITAGE VALUES OF THE DENİZLİ TRAVERTINE GEOPARK PROJECT, WESTERN TÜRKIYE

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Keywords: geoheritage, geosite, heritage stone, Pamukkale, Denizli Travertine Geopark project

The aim of this contribution is to introduce the prominent geological heritages and associated cultural values of the Denizli Travertine Geopark project in Turkey. The geopark area is located in the western Anatolian extensional province of the country. The geological heritage elements of the province are found within the Menderes Metamorphic Massif, Lycian Nappes, Oligocene molasse succession, Neogene continental deposits, Neogene volcanics and Quaternary formations (Özkul et al., 2025).

The gneisses and schists of the Menderes Massif exposed in the mountainous areas are the oldest rocks of the geopark territory. The shallow marine carbonate-evaporite occurrence of the Late Triassic within the Lycian Nappes, emplaced during the Late Cretaceous-Eocene period, is one of the rare outcrops. On the other hand, the late Oligocene molasse deposits, which are quite common in the province, are among the top 100 national geological heritage sites. The Neogene sedimentary fill of the Denizli Basin is unique and has different characteristics compared to the adjacent grabens. One of these differences is that the sequence contains the Paratethys mollusk fauna.

The geodiversity of the Neogene-Quaternary period is closely related to extensional tectonics that revealed horst-graben structures, normal faults, extensional fractures, mountain front alluvial fans and travertine formations. Among the Quaternary travertine formations, the world famous Pamukkale Travertine has been designated as one of the first 100 Geoheritage Sites. Furthermore, the fossil travertines of the region, called as Denizli Travertine (Özkul et al., 2024), was included in the first 55 heritage stones list of IUGS.

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GLOBAL STRATOTYPE SECTIONS AND POINTS (GSSPS): THE CONSERVATION OF TIME

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Keywords: GSSP, Chronostratigraphy, Jurassic, Geoconservation, Ammonites

System-focussed subcommisions of the International Commission on Stratigraphy (ICS) of IUGS are charged with the selection of sites at which to formally *define* global references for subdivisions of geological time. Key criteria include the completeness of the recorded rock succession and the range of correlative tools available (including biostratigraphical, geochemical and magnetostratigraphical). From initial selection by a Working Group to Subcommision followed by ICS approval, and finally IUGS ratification, this process of selecting a Global Stratotype Section and Point (GSSP) is scientifically the most rigorous of any 'geosite' selection process. However, as global references for a global time scale, protection and access for further study are also key criteria in the ICS selection process. As subcommissions are usually composed only of research scientists, however, the assessment of conserved status and guarantees of access for further study is rarely adequately assessed. Consequently, GSSPs can either have little or no protection (e.g. from development or irresponsible fossil collecting) and management (leading to their deterioration) or, conversely, be so highly protected that their use as a reference for future studies is virtually impossible. In addition, no global *conservation* designation framework exists through which such sites can be highlighted to national and regional conservation authorities (i.e. individual sites are too small to meet the requirements of UNESCO Global Geosites, not 'exceptional' enough for World Heritage status and the large number of GSSPs means that the IUGS, '100 sites+' programme cannot accommodate all ratified GSSPs). Crucially, none of these categories offer legal site protection as all rely on national legal frameworks which may or may not be applied or appropriate. With the development of the concept of Key Geodiversity Areas through IUCN, however, an appropriate framework will become available through which globally important sites such as GSSPs can be highlighted to national authorities for a special conservation status – although such a status must still allow continued study, without which a GSSP has no scientific utility. As an illustration of the current conservation status and issues affecting GSSPs a selection of Jurassic stage stratotypes will be presented and discussed.

GEOTOURIST MAPS IN HUNGARY

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Keywords: geotourism, cartography, thematic maps, geoheritage presentation

Maps are always the result of interpreting the environment around us, aiming to present a spatial object or phenomenon to the reader. While this may seem straightforward, the complexity of visualisation and the virtually unlimited number of themes to be mapped make effective cartographic communication challenging—whether in analogue or online format.

Throughout history, maps have played a crucial role in geoheritage, documenting significant geosites and landscapes. In the 18th and 19th centuries, advancements in cartography and geology led to the development of detailed geological maps – precursors to the maps we use today. In the 20th century, aerial photography and satellite imagery further enhanced geoheritage mapping, enabling more precise identification and conservation of geologically important sites. Today, digital mapping technologies continue to support the protection and promotion of geoheritage, ensuring that significant geological features are documented and accessible for future generations (Albert, 2019).

Tourists tipically use maps to navigate the physical environment and locate points of interest. As tourism evolved, so did cartographic products, adapting to the changing interests of visitors. With the rapid growth of the tourism industry in the 19th and 20th centuries, demand increased for semi-scientific or educational maps – particularly in the geosciences. As public interest in geological features grew, cartographers and scientists began producing maps that integrated traditional topographic content with geoscientific data. These early efforts laid the foundation for geotourist maps, designed to help the general public understand and correctly interpret geological-geomorphological phenomena (Bissig, 2018; Albert & Pál, 2022).

This work outlines the development of geotourist maps in Hungary, from their origins to the present. A wide variety of maps have been produced for different purposes and audiences. These vary in both scale and format, including small-scale (1:600,000, *Geological Curiosities of Hungary*), medium-scale (1:200,000, *Geological Map of Hungary for Tourists* and *GeoBlueTrail* maps) and large-scale examples (1:30,000, *Geological Hiking Map of the Surroundings of Csopak*). Despite differences in scale and thematic focus, their overarching goal remains the same: to provide accessible and valuable information about the Earth.

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THE GEODIVERSITY IN THE TULCEA COUNTY SITES (ROMANIA) - CASE STUDY: THE CODRU QUARRY

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Keywords: North Dobrogea, fossil heritage, collections, Upper Cretaceous

Limestone quarries are artificial openings of geological deposits, which often contain fossils. Sometimes, however, these quarries bring to light scientifically important paleontological associations or specimens. The Codru quarry located on the Viile Armenești Hill, near the road E87 (DN22) and close to Babadag town, is such a geological site. The stratified limestone strata here are of Lower Turonian age (Mirăuță & Mirăuță, 1964; Szász & Ion, 1988) and belong to the Dolojman Formation.

This site is important for the variety of well-preserved remains of plants, fish, inoceramids, echinoids, and ammonites. Also, in addition to the varied association, new plant species (*Geinitzia cretacea* and *Dryandra trifoliata* Givulescu & Lăcătușu, 1978) and a large Teleostean (*Osmeroides dobrogensis* Grigorescu & Marin, 1971), were discovered in this site, which gives it stratotype status. This movable geoheritage is preserved in the National Museum of Geology (NGM) and the Paleontology Laboratory Museum from Bucharest University (LP-UB) collections. Historically, one of the first citations about fossil plants in the Babadag Basin belongs to G. Ștefănescu ("Communication inédite", cited by V. Anastasiu, 1898). Our study is focused on corroborating all previous information about this site and its paleontological material stored in collections with new observation in the site and a new fossil extracted. With this occasion, part of the old collections was carefully reanalyzed. A complete paleontological list and a detailed biostratigraphic section for the Codru quarry is in progress.

In evaluating a natural or anthropogenic site, whether geological or even archaeological, one must always take into account, and at any time after its research and highlighting, the heritage extracted from it, which is very often forgotten in the pages of scientific writings or dusty drawers of collections and is not fully used for the benefit of society. Although the great scientific value of the Codru open pit site is known, its fossil heritage is largely unexploited for tourism.

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FROM BOREDOM TO BELONGING. HELPING STUDENTS FIND MEANING IN GEOPARKS

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Keywords: geoheritage education, student engagement, geopark-based learning, geodiversity awareness, community involvement

UNESCO Global Geoparks offer a unique learning environment grounded in geoscience, heritage, and sustainability. Yet a key challenge persists: how can we engage students who appear disinterested and transform their apathy into meaningful connection and participation?

This contribution presents practical approaches developed in the Hațeg Country UNESCO Global Geopark (Romania) that use creativity, inclusion, and real-world relevance to activate student curiosity and engagement with geoconservation topics. By fostering collaboration between university students and primary and secondary school pupils, and by encouraging creative exploration in schools throughout the geopark, these initiatives illustrate how transdisciplinary learning environments can be cultivated.

One such initiative, *Journey through European Geoparks*, was open to all schools across the Hațeg Geopark territory. The project invited students to explore geoparks from the European Geoparks Network and to present their geological and cultural features through research and public exhibitions. In a context where geoheritage education is embedded in community life, the project fostered authentic student connections with the values of the UNESCO Global Geoparks. Experiences shared by students and teachers demonstrated that collaborative learning, storytelling, creative expression, and international engagement can transform geodiversity from an abstract subject into a personal narrative. The initiative engaged over 100 students and 25 teachers from 12 schools across the geopark territory.

In parallel, a partnership between the University of Bucharest—through the Faculty of Psychology and Education Sciences —and local schools supported needs-based educational activities, tailored to the learning profiles of young pupils. Using games, observation, and interactive methods, pupils were encouraged to perceive nature as a dynamic environment where geological processes intersect with everyday experience.

Implemented in distinct but complementary settings, these initiatives show that geoparks can serve as catalysts for relevant, student-centered education. They promote not only the transmission of scientific knowledge, but also the development of a sense of belonging and responsibility toward Earth's geological heritage. This work reflects on how geoparks can harness their educational potential to inspire a new generation of curious, engaged citizens. These young people become aware of the value of geodiversity and committed to its active protection.

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GEOHISTORY. THE RECOVERY OF THE SCIENTIFIC LEGACY OF BARON FRANZ NOPCSA

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Keywords: geological heritage, paleontology, Hațeg Basin, dwarf dinosaurs, scientific interpretation, geopark conservation, history

In the year marking the 20th anniversary of the Hațeg Country UNESCO Global Geopark, this paper explores a comprehensive initiative to bring the scientific and cultural legacy of Baron Franz Nopcsa closer to the public. Nopcsa was the scientist whose paleontological research revealed the geological heritage that underpins the designation of this geopark.

This initiative is motivated, on one hand, by the opportunity created by the recent completion of the renovation works on Baron Nopcsa's family castle, located within the geopark, and, on the other hand, by the need to offer a balanced explanation of the turbulent historical and social context in which the scientist lived and worked. The early 20th century – the period when Baron Nopcsa discovered and studied the fossil remains of dwarf dinosaurs of Transylvania's, was a time when empires rose and fell, the First World War unfolded, nations were born, and borders were redrawn across Europe.

Therefore, the public presentation of the geologist and palaeontologist Franz Nopcsa is centred on science as a unifying force – one that bridges the divides of conflict, brings nations closer, fosters human connections, and shapes free spirits and open minds.

The initiative aims to transform a restored castle into an educational museum space that contributes to the interpretation of local geological and cultural heritage through the development of an innovative museum concept. The permanent exhibition is designed as a narrative experience, offering an integrated presentation of Nopcsa's life, work, and legacy, highlighting the many facets of his complex personality.

The exhibition layout combines classical museum interpretation methods with contemporary interactive technologies: immersive projections, digital reconstructions, touch panels, furniture, and scenographic elements. Each space is carefully designed to create a bridge between visitors and the world of Baron Nopcsa, encouraging learning, curiosity, and empathy.

We propose a model of sustainable interpretation that addresses several specific challenges: adapting to architectural constraints, integrating both tangible and intangible heritage, and creating a coherent and engaging narrative for diverse audiences. Thus, the recovery of Baron Nopcsa's scientific memory becomes an act of cultural re-signification, with both educational and touristic impacts at local and international levels.

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A NATIONAL GEOLOGICAL HERITAGE INVENTORY AS A TOOL FOR NATURE PROTECTION POLICIES

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Keywords: Geoheritage, France, conservation policies, environmental management, inventory data

In the early 2000s, the French Environment Code established the National Geological Heritage Inventory (called INPG in French). Now approaching its 20th anniversary, the INPG results are being used to apply and even drive public policies related to nature protection.

The quantitative assessment of geosites included in the inventory is based on two scores: one qualifies the site's heritage value, and the other assesses the need for its protection based on natural vulnerability and exposure to anthropogenic threats. Based on these two scores, it is possible to provide simple, easy-to-use tools such as maps that prioritize geosites in need of protection throughout the country. These resources currently help the State integrate geological heritage into its nature policy as part of the National Nature Protection Strategy (SNAP 2030). This policy aims to protect 30% of the national territory (both terrestrial and maritime) by 2030, including 10% under strong protection.

These inventory data can also be used for investigations into site management and monitoring (Bétard et al., 2023). For example, by cross-referencing geosite maps with existing protected and conserved areas, it is possible to assess the current state of protection and management of France's geological heritage. These assessments can be thematic (e.g. studying how sites of palaeontological or geomorphological importance are managed or protected) or related to specific protection tools (e.g. for example, are INPG geosites within protected areas less threatened than those that are not). Indeed, a study carried out on the INPG geosites that overlap with French Geoparks showed the positive effect of the Geoparks on the sites in the national geoheritage inventory. These positive effects are interpreted as good environmental management by the geoparks (Egoroff et al., 2022).

The INPG database thus serves both as a resource to advance the knowledge of geoheritage and as a tool for land management. This highlights the importance of having such inventories available to support the development of effective nature conservation policies.

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STRATOTYPES: A COLLECTION OF BOOKS TO PROMOTE A UNIQUE GEOLOGICAL HERITAGE

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Keywords: Edition, outreach, geoheritage, chronostratigraphic stage

Stratotypes, reference sections of chronostratigraphic stage, are key geological markers for understanding the measurement of geological time (Naidin, 1998; Murphy & Salvador, 1999). These international reference sites have a scientific, epistemological and geoheritage value, which makes them ideal for explaining a complex subject such as chronostratigraphy to an amateur geology audience. In 2008, the National Museum of Natural History and its team in charge of geological heritage launched a series of books dedicated to stratotypes to promote these reference sites (De Wever & Rouget, 2023). Each book is dedicated to a specific geological stage and all follow a consistent format: They all begin with an introduction to the chronostratigraphic scale and the concept of stratotypes, followed by a historical overview of the major contributors to the study of the stratotype featured. Two main sections then explore the geological context and palaeontological content of the stage, often incorporating new data (e.g. Lozouet, 2012; Neige & Dommergues, 2021), making the series a valuable resource for professional geologists as well.

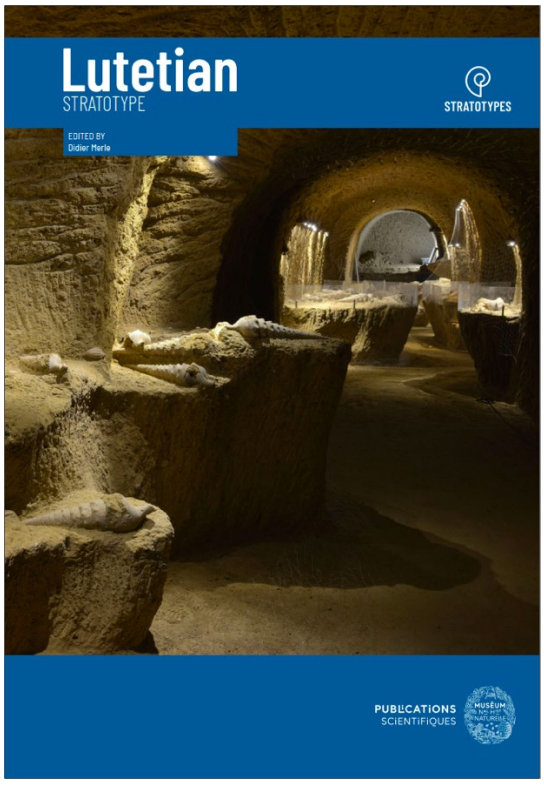

Fig. 1. Cover of the Lutetian Stratoytpe book published in 2025 (Merle 2025) (https://sciencepress.mnhn.fr/fr/collections/stratotypes/stratotype-lutetian).

The final two sections are dedicated to geoheritage and geoconservation—one examining human use of rocks, such as in architecture and remarkable buildings, and the other highlighting significant heritage sites of the geological stage, both within and outside the type locality. The sections within these books are accessible to all audiences and highlight the geology and culture of the region.

This collection, designed for stratotypes in France, currently includes ten books written in French. In 2025, the collection was expanded to include its first English-language volume (Fig. 1) – an eBook on the Lutetian stratotype (Merle, 2025) which was originally published in French in 2008. This updated version includes new palaeontological data and heritage information. Notably, in 2018, the Lutetian stratotype site gained protection under a new French law, which enables isolated stratotypes to be safeguarded.

In addition to engaging both professional and amateur geologists, the 'Stratotypes' collection is also a tool for raising awareness of these reference geosites among a wide audience and encouraging local authorities to support their geoconservation.

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FINE-SCALE GEODIVERSITY IN NORTHERN ECOSYSTEMS – IMPORTANCE FOR BIODIVERSITY AND ENVIRONMENTAL MANAGEMENT

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Keywords: geofeatures, qualitative-quantitative, biodiversity, land use

Introduction

This presentation summarizes the key findings of my doctoral dissertation, which explores how fine-scale geodiversity can be measured, how it varies, and how it relates to biodiversity (species richness and evenness) in northern tundra and heath ecosystems. It also examines the impact of land use in northern ski resorts on geodiversity. The thesis includes four articles that apply ecological methods to geodiversity research.

I Fine-scale geodiversity data

A new field method by Hjort et al. (2022) offers a novel way of collecting fine-scale geodiversity data from different environments. I briefly introduce this method, which produces a measure of georichness i.e. the number of distinct geofeatures (geological, geomorphological, and hydrological features) in a study plot. Fine-scale geodiversity provides unique knowledge of the abiotic environments and their interplay with biodiversity and soil characteristics, and it can be assessed from both natural and disturbed locations.

II Georichness is related to species richness

Salminen et al. (2023) found that greater georichness indicates greater species richness of vascular plants, bryophytes and lichens in northern mountain heaths and tundra. However, this relationship is context-dependent, with other factors playing a larger role in some areas. Ongoing study (Salminen H. et al., manuscript) points out that in northern boreal forests, where the range of different geofeatures encountered at the study plots is smaller, georichness remains a strong predictor of species richness.

III Land use affects the quality of geodiversity

A study in northern Finland ski resorts (Salminen H., Huusko et al., submitted manuscript) shows that geodiversity tends to be lower in areas that are highly impacted by land use. We found different types of geofeatures from areas of low, medium and high land use intensity, suggesting geodiversity's vulnerability to human disturbance.

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GEOLOGICAL HERITAGE OF THE CIMMERIAN DOBROGEA GEOPARK – INVENTORY, ASSESSMENT AND THREATS

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Keywords: nature reserve, geosite, fossil site, abandoned quarry, mining works

The natural heritage of the Cimmerian Dobrogea Geopark project is protected through a national park and the Natura 2000 network, which comprises 10 SCIs and SPAs, including a total of 31 designated nature reserves. Among these, 16 are directly relevant to the Geopark's geological heritage.

Two paleontological reserves have been established by law within the Geopark area. The Bujoare Hills fossil site represents the only outcrop exposure of Lower Devonian macrofauna in Romania, while the Agighiol Geological Reserve preserves a rich Triassic macro- and microfauna. The ammonite assemblages of Agighiol were first described in classic paleontological monographs more than a century ago (Baltres, 2005, and references therein). In addition, several mixed type reserves also possess significant geological relevance for the Cimmerian belt (Seghedi et al., 2018, and references therein). The Consul Hill Nature Reserve constitutes an E–W cross-section through the Consul tectonic unit, displaying high-angle thrusts, whereas the Chervant–Priopcea Reserve preserves Variscan structures subsequently overprinted by Cimmerian or later deformation phases.

The Geopark's geosite inventory includes 95 locations of scientific importance, covering frameworks of sedimentation, magmatism, and tectonics, alongside outcrops of paleontological, stratigraphic, petrographic, and structural significance. One of the most important geosites is Deșli Caira proposed as a candidate Global Boundary Stratotype Section and Point (GSSP) for the base of the Anisian (Balini et al., 2024). Another site of exceptional significance, unique in Romania, is the Ediacaran outcrop in the Casimcea Nature Reserve, which preserves fossil imprints of *Aspidella* (Saint Martin et al., 2013). The Ediacaran consists of turbidites comparable with deep-marine successions from Charnwood Forest (England) and Mistaken Point (Canada). The geosite inventory comprises type localities of Paleozoic and Mesozoic formations, 28 abandoned quarries and former mining sites, which present significant potential for the development of thematic trails focused on rock exploitation and the mining heritage of Dobrogea.

The main threats to the geoheritage include waste dumping (Casimcea, Tariverde, Nalbant, Tulcea), fossil collecting (Agighiol), quarrying within reserves (Bujoare Hills), and, more rarely, natural erosion (Igliţa). Abandoned quarries of high scientific value are particularly at risk of being converted into landfills. The Cimmerian Dobrogea Geopark partnership project is regarded as the most appropriate framework for ensuring the effective management of geological heritage, while simultaneously fostering the sustainable socio-economic development of the region. Awareness raising through thematic trails and educational programs and activities like those developed in geoparks could be a solution to protect the geoheritage.

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SUSTAINABLE ACTIVITIES IN OLTENIA DE SUB MUNTE - ASPIRING UNESCO GLOBAL GEOPARK

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UNESCO Global Geoparks provide an innovative framework for territorial development, where natural and cultural heritage becomes a resource for education, responsible tourism, and community engagement. In Romania, the aspiring UNESCO Global Geopark Oltenia de sub Munte offers a sustainability model built through over two decades of local effort. It began with the establishment of Buila-Vânturarița National Park by the Kogayon Association, with the goal of nature conservation, and has since grown to include local communities in its programs - communities that can thrive in harmony with nature. Today, the territory of Oltenia de sub Munte includes over 150 local and national partners and is part of the international Bioregional Weaving Labs network (in partnership with Ashoka, Commonland, OpEPA).

The aspiring UNESCO Global Geopark Oltenia de sub Munte is located in Vâlcea County and spans 635.58 km², covering six municipalities: Vaideeni, Horezu, Costești, Bărbătești, Stoenești, and Băile Olănești. It stretches from the peaks of the Căpățânii Mountains in the north to National Road 67 in the south, and from the border with Gorj County in the west to Băile Olănești in the east. The geopark encompasses 39 villages and two resort towns, with a total population of over 23,000. Beyond its rich mosaic of geodiversity, biodiversity, and cultural heritage, the area also features two UNESCO World Heritage designations - Hurezi Monastery and the traditional craft of Horezu pottery - as well as a national park, three Natura 2000 sites, 15 natural reserves, and 1,302 hectares of virgin forests. The sustainability of the geopark's activities is supported by four pillars: nature conservation, education, responsible tourism, and local sustainable development. Few sustainable activities in our region:

1. **Junior Ranger Environmental Education Program**, which has taken over 5,000 children to educational camps in nature, so far
2. **The Fireflies Festival**, the flagship event of Oltenia de sub Munte, now at its fourth edition, supports small local producers. Workshops are led by local community members (weaving, pottery, entomology, fossils, etc.), and the funds are reinvested locally. It is an example of sustainable and experiential tourism, offering participants an immersive experience in the region's natural and cultural landscape
3. **Local Microgrant Program**, which gathered entrepreneurial ideas from the community and provided financial support to those with the greatest potential for local impact
4. **Urban Nature Network**, which aims to protect urban nature and integrate biodiversity conservation into urban planning. It promotes 18 natural areas in 10 Romanian cities through identification, documentation, and mapping - for education, recreation, sport, and nature observation. It also functions as ambassadors of the geopark heritage
5. **Romanian Geoparks Network**, which supports communities in areas with exceptional natural and cultural value, ensuring these treasures are protected for future generations
6. **Applied Research Hub**, designed to connect research beneficiaries - mainly from the two networks mentioned above - with those who conduct studies and applied research.

This open model enables the development of a local green economy where people work with nature, not against it, and directly benefit from conservation efforts. The geopark thus becomes a living example of applied sustainability: a space where nature, culture, and communities support one another in a long-term process deeply rooted in local identity. The initiatives in Oltenia de sub Munte – aspiring UNESCO Geopark show how a community can build a sustainable future by protecting its own values and connecting them to a global network.

BEYOND TRADITIONAL ASSESSMENT METHODS: RETHINKING GEOHERITAGE VALUES FOR ITS PROMOTION AND GEOTOURISM DEVELOPMENT

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Keywords: geoheritage assessment, general public visitors, holistic approach

Over the last two decades, numerous methods for assessing geoheritage have been developed. These approaches primarily emphasize scientific importance and often focus narrowly on specific geo-related aspects, prioritising geoconservation efforts.

However, when it comes to promoting geoheritage to a broader audience, as in the case of geotourism, this approach often overlooks essential factors, including public preferences and motivations. This oversight results in assessment outcomes that offer limited practical value for supporting sustainable geotourism development and attracting visitors, particularly the general public, who comprise the majority of visitors who often have little to no geological knowledge. The method also fails to account for various dimensions of geoheritage, including visual appeal, safety, infrastructure, and cultural or historical significance – all of which are vital for tourism. By broadening the evaluation criteria to include these aspects beyond scientific parameters, the framework can provide a more comprehensive view of geoheritage values related to geotourism, recognising its multifaceted nature and its links to cultural and natural landscapes.

This contribution introduces a new approach to assessing geoheritage for adequate support of geotourism development. The methodology incorporates 10 assessment categories, each including a set of criteria that reflect public preferences and a broader range of geoheritage values from a (geo)tourism perspective.

The utilisation of results derived from such a comprehensive assessment directly enhances the effectiveness of geotourism initiatives. These results provide actionable insights that facilitate the development of customised interpretive programs, targeted marketing strategies, and improved visitor infrastructure. Ultimately, employing these holistic assessments ensures that geotourism projects are not only grounded in scientific rigour, but are also optimally designed to maximise visitor engagement and experience, promote long-term sustainability, and have the potential to generate economic and social benefits for local communities.

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INTEGRATING GEODIVERSITY INTO THE SEVEN PRINCIPLES OF RESILIENCE

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Keywords: geoheritage, socio-ecological systems, resilience building, review

Resilience has become a central concept in addressing the growing complexity and urgency of global environmental and societal challenges, both in research and policy (Folke, 2016). From climate change and nature loss to land degradation and natural hazards, resilience thinking offers a framework for understanding and strengthening the capacity of human–environment, or socio-ecological systems to absorb disturbances, adapt to change, and transform in response to ongoing crises and pressures. Efforts to enhance resilience call for integrated, systemic approaches. Yet, these often emphasize biological dimensions of nature, or position abiotic nature to a secondary role supporting biodiversity. Even when the physical environment is considered more broadly, the absence of clear terminology (such as "geodiversity") limits recognition of its value. As a result, the potential of geodiversity to inform resilience building remains underexplored.

To address this gap, we review literature at the intersection of geodiversity, geoheritage, and resilience. We examine how resilience is conceptualized in relation to geodiversity, what connections are being made, and what opportunities exist for deeper integration. Our analysis is structured around the seven principles for building resilience in socio-ecological systems (Biggs et al., 2012), a widely adopted framework in resilience assessments. These principles – (1) maintaining diversity and redundancy, (2) managing connectivity, (3) managing slow variables and feedbacks, (4) fostering complex adaptive systems thinking, (5) encouraging learning, (6) broadening participation, and (7) promoting polycentric governance – offer a lens through which to explore how geodiversity can contribute to more holistic resilience strategies. The presentation illustrates each principle with examples from geodiversity and geoheritage research.

This work invites geodiversity and geoheritage scholars to engage more systematically with resilience thinking and encourages resilience researchers to adopt geodiversity-inclusive perspectives. Enhancing the visibility of geodiversity within resilience literature enables developing more comprehensive and effective strategies for managing and governing complex socio-ecological systems.

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INTERPRETING "THE TREASURES OF AGIGHIOL": A THEMATIC TRAIL IN THE CIMMERIAN DOBROGEA GEOPARK INITIATIVE, ROMANIA

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Keywords: geoheritage interpretation, fossils, biodiversity, archaeological heritage

This paper presents the interpretive framework and the process of developing the thematic trail "The treasures of Agighiol". Located in the Cimmerian Dobrogea Geopark Initiative, Romania, this 5 km hiking route covers the geology and biodiversity area of the Agighiol Hills, a Natura 2000 site, which reveals over 250 million years of geological history and 4000 years of cultural memory. The interpretive concept is developed on the idea that these hills safeguard *scientific, ecological, and historical treasures* – from Triassic ammonites and ichthyosaurs to the 4th century BC Agighiol Getic treasure and endemic biodiversity or species of conservation interest, such as the Dobrogea tortoise – *Testudo graeca ibera*, a nature monument, and the wild Romanian peony *Paeonia peregrina* Mill. var. *romanica*.

Fig 1. School children visiting the trail during the Green Week 2025.

The interpretive panels use storytelling, dialogue with historical figures (e.g., the paleontology professor Ion Simionescu), humorous fictional characters (e.g., "Sophocles Shastasaurus"), and symbolic language to translate complex geoscientific content into accessible and relatable messages. The trail invites visitors to experience the interaction between geological time, biological adaptation, and human heritage – picturing geoheritage as both a scientific repository and a living cultural landscape. The result enhances the visitors experience and informs and inspires stewardship and emotional connection to place.

The thematic trail "The treasures of Agighiol" case study illustrates a holistic interpretive strategy that supports the goals of UNESCO Global Geoparks and aligns with the ProGeo mission to communicate geoscience effectively to the public.

THE IMPACT OF ROCKFALLS ON NATURAL CLIMBING SITES IN SLOVENIA

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Keywords: geoheritage management, geodiversity, natural values, spatial analysis, rockfalls impact

Rockfalls represent a significant natural hazard affecting both the safety and accessibility of climbing walls, with growing implications for geotourism and geoheritage preservation (Vassilakis et al. 2024). The study presents the impact of rockfall events on climbing sites in Slovenia, highlighting the need for integrated risk assessment and site management strategies.

The methodology includes (i) collection of climbing sites as points; (ii) correction of the Slovenian climbing site data due to inaccurate locations; (iii) identification of climbing sites at risk based on the probability of rockfall occurrence; (iv) spatial analysis of climbing sites within or near natural values and rockfalls.

A total of 89 climbing sites were analysed across Slovenia. Most of them fall into lower-risk rockfall hazard categories, with 46 climbing sites classified at very low and 28 at low probability of rockfall occurrence. However, 14 sites are in the medium and another 14 into the high probability category, while one site is exposed to a very high probability of rockfall occurrence. A spatial analysis of climbing sites within or nearby natural values showed that no rockfalls were recorded within 50 meters of the climbing sites; however, eight rockfall events were documented at 200, 250, and 300-meter distances from the sites, suggesting a trend of increased activity slightly farther from the walls.

The results highlight the importance of accurate climbing site mapping and targeted risk assessment in managing climbing sites exposed to rockfall hazards. With a notable number of sites falling into medium to high-risk categories and several located near recorded rockfall events, there is a clear need for proactive site management and integrated conservation strategies to ensure both climber safety and the preservation of geoheritage.

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WHAT ON EARTH IS GEODIVERSITY ─ THE COLLECTION OF VIEWPOINTS IN RESEARCH AND APPLICATIONS

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Keywords: Assessment, Geodiversity values, Geopark, Health, Research

Over the decades of geodiversity research, a range of viewpoints has emerged, enriching the ways in which geodiversity is interpreted and applied. This variety, however, can make it challenging to fully grasp the concept, especially for those encountering the term for the first time.

In this presentation, we provide an overview of current viewpoints on geodiversity and examine their relevance to different audiences (following Tukiainen & Toivanen, 2025). These viewpoints include:

1. Definitions – *How is geodiversity defined?*
2. Assessment – *How is geodiversity assessed?*
3. Research field perspectives – *How is geodiversity perceived or understood across disciplines?*
4. Terminology – *What terms are commonly associated with geodiversity?*
5. Practical applications – *Where is geodiversity information applied?*
6. Stakeholders – *Who benefits from, or requires information on geodiversity?*

Furthermore, our presentation provides concrete examples illustrating these viewpoints and connects them to the various values associated with geodiversity, with a particular focus on northern environments within the Rokua UNESCO Global Geopark in Finland. Since geoparks are designated areas where geodiversity is actively studied, managed and valued, they are excellent areas for providing example cases. For instance, we scrutinize how geodiversity within geoparks can be valuable to a wide range of stakeholders and practical applications through its functional values, such as supporting human physical and mental health and well-being (Lankila et al., 2025).

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NATIONAL GEOPARKS IN THE CZECH REPUBLIC: DEVELOPMENT AND MANAGEMENT

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Keywords: geoheritage, geosites, geotourism, interpretation, sustainable development

Following the example of European initiatives for establishing geoparks, a national network of geoparks began to emerge in the Czech Republic in 2010 (Fig. 1). The fundamental framework for their establishment, development, and administration was created in accordance with the Global Geoparks Network system and further specified in the Directive of the Ministry of the Environment in 2018.

The primary coordinating body of the national network is the Council of National Geoparks of the Czech Republic, established by the Ministry of the Environment. The Council is responsible for decisions regarding the certification of areas as national geoparks and for facilitating support opportunities within the ministry's remit.

Fig. 1. Official logo of the National Geoparks Network in the Czech Republic, coordinated by the Ministry of the Environment. The logo represents certified territories preserving geological heritage and promoting sustainable development.

A national geopark is a territory that represents the geological heritage of the Czech Republic and possesses a strategy for sustainable development. Each geopark has clearly defined boundaries and presents the geological evolution of the Earth, while also illustrating how local natural resources have influenced the economic and cultural development of society. Geoparks are created through voluntary collaboration among various stakeholders within the territory and in close cooperation with the state nature protection authorities. A national geopark includes geosites of exceptional scientific, educational, and aesthetic value, representing the country's geological heritage.

When a new geopark is proposed, the Council first decides whether to accept the territory as a so-called "candidate national geopark." This provisional status can last for a maximum of five years, during which time a detailed nomination dossier must be prepared according to a fixed structure. The Council meets twice a year and, based on evaluation forms, assessments by mentors and validators, decides whether to register a territory as a candidate or to recommend it to the Minister of the Environment for certification as a "national geopark". Each certified geopark undergoes regular revalidation by the Council every four years to retain its status.

As of 2025, a total of eleven national geoparks in the Czech Republic have been awarded certification. The first Czech member of the European Geoparks Network (EGN) in October 2005, which later became a member of the UNESCO Global Geoparks Network, was the Bohemian Paradise Geopark.

NATIONAL GEOPARKS OF THE CZECH REPUBLIC

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Keywords: sustainable tourism, cultural landscape, geodiversity, environmental education

Geoparks are living landscapes that open a window into the deep past of our planet, telling the awe-inspiring story of Earth's 4.6-billion-year journey. Through dramatic rock formations, fossil records, and ancient landforms, each geopark invites visitors to explore the powerful natural forces that have shaped our world over vast spans of time.

At the heart of every geopark lies a unique geological heritage — a silent yet eloquent witness to the ever-changing face of the Earth. Visitors are guided through this story by way of marked trails, interpretive sites, and educational experiences that bring geology to life.

But a geopark is more than just a story of rocks. It is a story of people. The geology of a region has always influenced how and where people live — shaping settlement, agriculture, architecture, culture, and traditions. Geoparks celebrate this vital connection between nature and culture, science and storytelling, past and present. They promote environmental education, support sustainable tourism, and help protect both natural and cultural treasures.

a b c

Fig. 1. The diversity of the Czech Republic's geological landscape is reflected in the variety of its national geoparks (NG): a, NG Bohemian Paradise; b, NG Barrandien; c, NG Egeria.

The Czech Republic is home to a remarkable collection of national geoparks –11 certified areas where geology, nature, history, and culture intertwine. The creation of them has been driven by the initiative of local people, who remain actively involved in their management and development through associations and volunteer groups. Each geopark highlights the extraordinary geological heritage of its region while revealing the profound relationship between the landscape and the people who have inhabited it for centuries. An inseparable part of these geological stories is the region's rich mining and metallurgical heritage, which has shaped both the land and the character of local communities.

Thanks to the country's geodiversity — with rocks representing nearly every chapter of Earth's history –Czech geoparks are wonderfully varied and unique. An overview of all national geoparks in the Czech Republic can be discovered on the poster presentation. Altogether, they cover 9,000 square kilometers – more than 11% of the Czech Republic's landscape.

KARCZÓWKA HILL IN THE HOLY CROSS MOUNTAINS UNESCO GLOBAL GEOPARK (POLAND) – HOW TO IMPROVE GEOLOGICAL INTERPRETATION TO MAKE IT MORE TOURIST-FRIENDLY

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Keywords: geoheritage, geopark, geotourism, interpretation, geological heritage, mining heritage

Karczówka Hill, located within the Holy Cross Mountains UNESCO Global Geopark, represents one of the most significant sites in the region, both geologically and culturally. Built of Devonian limestones and Permian conglomerates, it is characterized by calcite-galena mineralization related to tectonics and karst forms, as well as traces of historical lead ore mining, outstanding landscape and cultural values. Since 1953, Karczówka Hill has been under legal protection as the "Karczówka" landscape reserve.

In 2012, a geological-mining interpretive trail with nine information panels was established to showcase the site's geological and mining heritage (Wróblewski, 2012).

Since its creation, significant changes have occurred in the management and interpretation of sites. In the Botanical Garden, located on the SW slope of the Karczówka Hill, geological outcrops have been revitalized to display Upper Devonian rocks with tectonic and hydrothermal mineralization, as well as karst forms. Within the Botanical Garden, there are also traces of historical lead ore mining, next to which a monument of Hilary Mala – a legendary miner who was supposed to have extracted a lump of galena in the 17th century – was erected. From the largest lump found, a sculpture of Saint Barbara was made, which is still on display in the church at Karczówka (Złonkiewicz & Fijałkowska-Mader, 2018).

In light of these developments, the authors advocate for updating and expanding the interpretive trail. This should not only include new geotourism features but also integrate elements of local stoneworking traditions, such as the use of Devonian limestones, Permian conglomerates, as well as Triassic and Jurassic sandstones in the monastery complex, as detailed by Złonkiewicz and Fijałkowska-Mader (2018).

The proposed panels should follow contemporary principles of effective geoheritage interpretation: using plain language, appealing graphics, connections to everyday life and emotions, and incorporating interactive components (Macadam, 2018; Štrba & Palgutová, 2024). This approach aligns with best practices in geotourism and education, promoting informal, engaging learning and sustainable heritage management. Enhancing interpretive quality in this way may strengthen the relationship between visitors and geological heritage, contributing to geotourism development and public geoscience awareness.

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DEVELOPMENT STRATEGY OF GEOSITES BY LINKING GEOLOGICAL PROCESSES WITH NON-GEOLOGICAL RESOURCES OF THE SAMCHEOK GEOPARK IN KOREA

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Keywords: geosite, geopark, geotourism, non-geological elements

High geodiversity in Samcheok City, Korea, is characterized by Precambrian metamorphic rocks, Paleozoic sedimentary rocks with coal mine, Miocene lacustrine sedimentary rocks, and Quaternary travertine and cave speleothems, together with various Cretaceous rocks including terrestrial sedimentary rocks, volcanic rock (rhyolite), plutonic rock (granite), and pyroclastic rock (tuff). Geomorphic diversity can be also added by high mountain range in the west, coastal erosional and/or depositional landforms along the eastern seacoast, various karst landforms and caves of different genetic stages, and waterfalls with specialized ecological habitats provided by karst springs.

Conventionally geosites in geoparks are determined based on geoheritage values and geotourism potential, as well as various and different geodiversity elements. Here, we present additional criteria for selecting geosites by linking geological processes with ecological and cultural features. These include specialized ecological habitats provided by karst springs (Mugeonri Moss Waterfall and freshwater laver along the Sohan Valley stream from the Chodang Cave), limestone caves with special distinctive salamanders (Hwanseon and Gwaneum caves in Daeiri cave area), Old train trail along the deep mountain valley (Deokpung Valley), Polluted stream from old mine area (Miin Waterfall and Tongri Gorge), fluvial erosional process (Jukseoru fluvial landform), waterbirds near the river mouth and intangible tradition festival (Deokbongsan coastal depositional landform), and coastal ecosystems along the rocky shoreline (Jangho coastal landform and its related ecosystem and Chogok coastal erosional potholes and a sea cave with separate and independent ecosystem). The tour stories based on the intimate relationship between geodiversity, biodiversity and cultural diversity, would increase tourist attraction to promote geotoursim, and may play a significant role in increasing public awareness of geological features.

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