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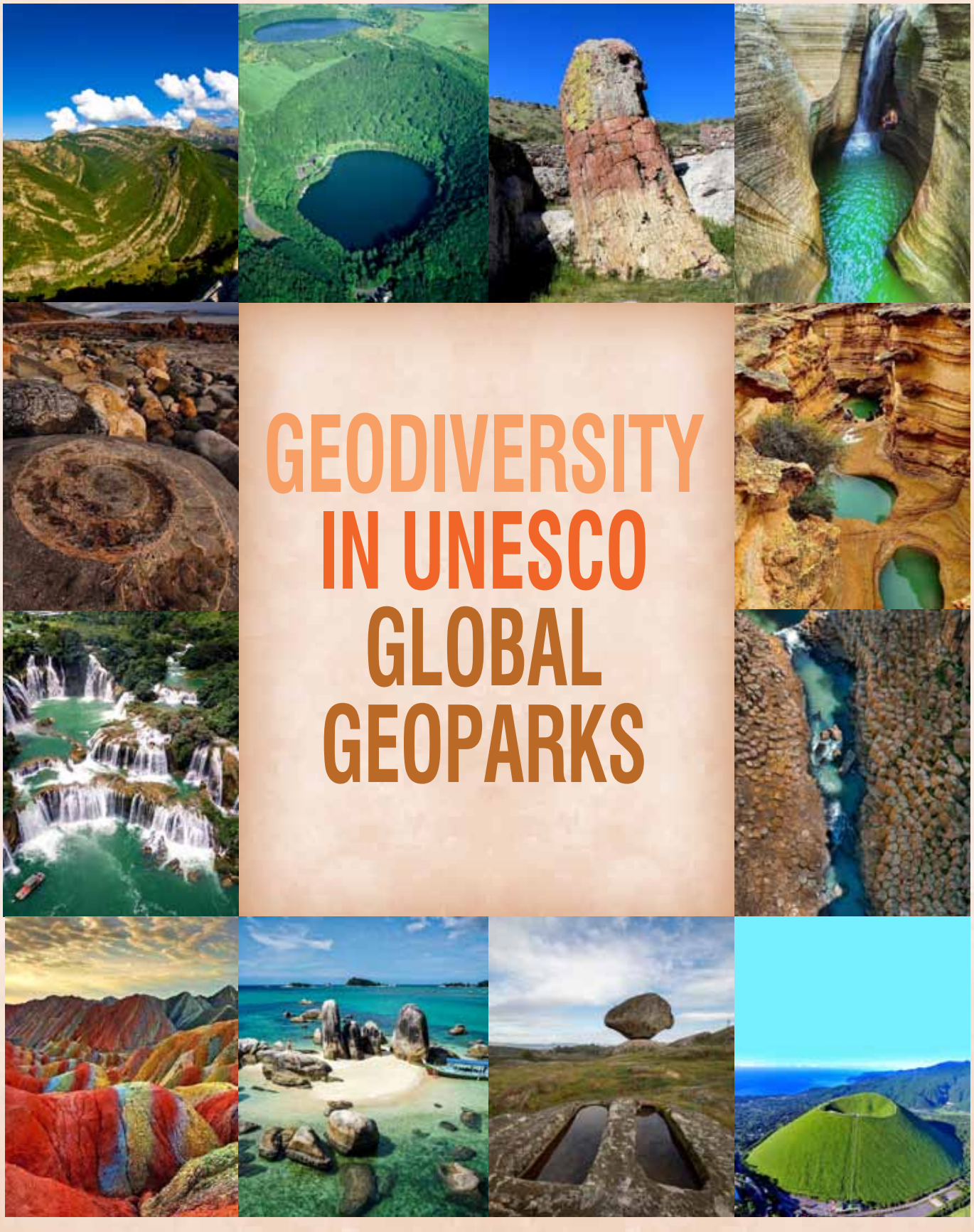

GEODIVERSITY IN UNESCO GLOBAL GEOPARKS

INTERNATIONAL GEODIVERSITY DAY
THE DIVERSITY SUSTAINING THE LIFE

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Chair on Geoparks
and sustainable development
of insular and coastal areas.

UNIVERSITY OF THE AEGEAN

GLOBAL GEOPARKS NETWORK

Geodiversity in UNESCO Global Geoparks

Published by:
Global Geoparks Network

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Useful information related to UNESCO Global Geoparks can be found on the following websites:
http://www.unesco.org/new/en/natural-sciences/environment/earth-sciences/unesco-global-geoparks
http://www.globalgeoparksnetwork.org
www.visitgeoparks.org

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6TH OCTOBER
INTERNATIONAL GEODIVERSITY DAY

GEODIVERSITY IN UNESCO GLOBAL GEOPARKS

The Global Geoparks Network, in collaboration with the UNESCO Global Geoparks Secretariat, celebrates International Geodiversity Day 2022. All UNESCO Global Geoparks, their partners and stakeholders are asked to join the campaign to raise awareness of the value of Geoparks as unique territories with Geological Heritage Sites of international significance and as custodians of the Memory of the Earth!

The 6th of October 2022 is the world's first celebration of the International Geodiversity Day. It is an annual global celebration which was approved on the 22nd of November 2021 by 193 Member States during the 41st UNESCO General Conference following a proposal from 109 international and national organizations, including the Global Geoparks Network (GGN).

UNESCO Global Geoparks are areas of high geodiversity. Rocks, fossils, minerals, landforms, soils, and the natural processes, that continually shape them, are components of their geodiversity. Geodiversity is the basis of biodiversity and for human cultures and their activities.

The Global Geoparks Network, in collaboration with the UNESCO Global Geoparks Secretariat, invites you to discover the uniqueness of the UNESCO Global Geoparks' geodiversity through the following activities coordinated by the Global Geoparks Network to celebrate the world's first International Geodiversity Day on the 6th of October 2022:

- Enjoy the following **video** which presents exceptional examples of the UNESCO Global Geoparks' rich geodiversity:

https://globalgeoparksnetwork.org/?page_id=2934

- Join the Global Geoparks Network **Facebook page campaign** and discover the five most important Geological Heritage Sites in each of the 177 UNESCO Global Geoparks from 46 countries:

https://www.facebook.com/globalgeoparksnetwork

The Global Geoparks Networks social media campaign includes a variety of promotional banners as well as posterss.

- The Global Geoparks Networks social media campaign also promoted **field activities** organized by UNESCO Global Geoparks to celebrate the first International Geodiversity Day by providing schools, local inhabitants and visitors to engage with and understand the value of geodiversity in their territory.

- Connect to the following YouTube link and watch the **digital event** organized by the Global Geoparks Network in collaboration with the UNESCO Global Geoparks Secretariat for the celebration of the International Geodiversity Day on the 6th of October 2022:

https://www.youtube.com/channel/UCUghhLY2w-e8YMUHoa6JGBbQ

During this event the UNESCO and Global Geoparks Network Grant for Africa, the Arab States and for the Small Island Developing States was announced..

- Explore the geodiversity of UNESCO Global Geoparks in this GGN new publication "Geodiversity in UNESCO Global Geoparks" in which articles with photos of the various significant geosites in UNESCO Global Geoparks are presented.

Let's make the International Geodiversity Day a great moment for all Geoparks and their communities!

Azores UGGp, Portugal - Europe

Nine Islands - One Geopark: Where geodiversity becomes identity

Rocha dos Bordões (Flores island).

(Photo by Eva Lima).

Volcanic ridge (SJorge island).

(Photo by Eva Lima).

The Azores UNESCO Global Geopark's (UGGP) territory is composed of nine islands and several islets that emerged from the Atlantic Ocean's seabed, through the process of volcanic activity. This activity is strongly connected to the geodynamic context present in this region of the globe, and is affected by the existence of the Mid-Atlantic Ridge.

Despite the volcanic origin of the archipelago, all the islands present a unique and distinguished geodiversity. The different types of volcanic activity contribute to the variety of landscapes and volcanic products that result either from an acidic or basic composition, with eruptions ranging from explosive to effusive thus resulting in various volcanic forms and deposits.

The Azores UNESCO Global Geopark is an authentic mosaic of volcanic geodiversity, which allows us to tell the story of this territory, the story of Azoreans, a story that started around 6 million years ago, with the volcanic formation of these islands. The volcanic substrate, isolated in the middle of the Atlantic Ocean, became the stage for life, allowing the appearance of a unique biodiversity represented by native and endemic species. As a consequence of time, the inhospitable volcanic landscapes became inviting for humans, providing fertile soils, geothermal resources and magnificent landscapes. Despite several historical eruptions and earthquakes witnessed by Azoreans, this geological setting has become the essence of their identity and is represented in the traditions and religious practices existing in all islands.

The azorean geodiversity is part of Azoreans life and cannot be dissociated from the people. Unique coastal landscapes, calderas, small and large volcanoes, lagoons and waterfalls, emblematic prismatic joints, magnificent volcanic caves represented by lava tubes and volcanic pits with a unique fauna, lava fields flourishing with vineyards, the telluric heat in the form of fumaroles and hot springs, ruins of lighthouses, churches and houses that are testimonies to recent eruptions and earthquakes.

It is the role of the Azores UNESCO Global Geopark to preserve the identity of the archipelago through the promotion and conservation of its geosites. Protecting them through geoconservation activities, such as frequent monitoring and providing a cohesive educational programme that promotes the knowledge and the care for the azorean geodiversity. The promotion of this geodiversity is maintained by the Geopark and its partners, working towards the creation of a distinct geotouristic offer that allows visitors to discover all aspects of the azorean heritage, natural and cultural.

The geodiversity in the Azores is the first step for the understanding of Azorean identity, discovering it is discovering the Azores UNESCO Global Geopark, a mosaic of volcanic landscapes and traditions.

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Pico Mountain volcano (Pico island).

(Photo by Paulo Henrique Silva Siaram).

Vila Franca do Campo islet.

(Photo by Paulo Pereira).

Apuan Alps Uggp, Italy - Europe

Geodiversity Sites in the Apuan Alps Geopark

The underground touristic trail inside the Corchia Cave, equipped with stainless steel bridges.

Mt. Forato Arch with its iconic "window" (32 m wide x 26 m high).

The Apuan Alps (Tuscany, Italy) preserve exceptional examples of geodiversity based on its world-famous marbles and minerals, as well as on karst systems, traces of glaciations and tectonic structures.

As a UNESCO Global Geopark, the Apuan Alps UGGp works for promoting and disseminating the value of its geoheritage. Therefore, alongside the geosites, several geodiversity sites with educational, touristic and cultural values have been identified. Here we present three geodiversity sites that are among the most beloved by tourists, as an example of the Geopark's holistic approach celebrating geoheritage together with cultural and natural heritage to provide a narrative of its territory.

The Corchia Cave is the largest Italian karst system with galleries more than 60 km long developed along four different levels over a depth of more than 1000 m, revealing isostatic balance vs stages of uplift of the Apuan Alps. Its speleothems preserve the palaeoclimate archives of the Mediterranean area for the last million years. The relevance of the Corchia Cave, first explored in 1840, is also related to its historical contribution to the progress of speleological exploration. Thanks to the creation of an underground trail along 1 km of natural galleries, the Corchia Cave is now the most visited tourist attraction in the Apuan Alps UGGp.

The Mt. Forato Arch is one of the largest Italian natural rock arches, forming the main watershed of the central-southern Apuan Alps. The arch resulted from the early development of two main fracture systems affecting marble and dolomitic marble; the intersection between these two fracture systems and their progressive widening led to the isolation of rock blocks that collapsed under the influence of gravity.

Many legends and folk tales originated around this iconic mountain and its silhouette has inspired artists for centuries.

The interpretative panel of the Mt. Forato arch is located in Cardoso Village. From there, it is possible to admire the landscape and reach Mt. Forato by hiking on one of the most popular paths in the Apuan Alps.

The Giants' pot-holes of the Apuan Alps are mainly concentrated along two streams, Anguillaja and Fatonero, where dozens of large pot holes have been sculpted inside the marble.

At the beginning of the path, in connection with the riverbed of the Tùrrite Secca stream, a panel describes the scientific importance of this stream, which allowed the Italian geologist Antonio Stoppani to observe and understand the process of sub-riverbed water flow in 1872. Another panel explains the formation of these fluvial landforms, due to the abrasive action of rotating pebbles transported by the streams.

A third panel contains a poem that evokes a pothole that was destroyed to obtain a marble block; the warning is that these outstanding elements of the geoheritage must be protected and preserved.

"The Giants" Potholes along Anguillaja stream.

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Arxan UGGp, China - Asia

Geodiversity in Arxan Geopark

Turtleback lava

Dichi Volcanic depression lake

Arxan UNESCO Global Geopark (Arxan UGGp) is located at the point where the eastern Tianshan-Xing'an fold zone amalgamates with the Daxing'anling giant uplift belt of the Cathaysian tectonic system. It is a topographic boundary zone in China and a crustal transition zone. Arxan UGGp has a remarkably rich geodiversity that includes diversified geology, volcanic landforms, natural springs, and assemblages of associated features and processes, which gave rise to the names "Hot Spring Holy Land" and "Volcano Kingdom".

Arxan UGGp includes a wide range of volcanic cones, lava flows, and volcanogenic lakes. Powerful, primarily alkaline basaltic eruptions left 46 volcanic structures and lava platforms on both sides of the Arxan River. Many lava landforms mentioned in volcanology literature or pictorials can be found well preserved in this area. In particular, the turtleback lava structure is the only large-scale, well-developed example in China. Moreover, in a 40 km^2 area of Shitanglin, hundreds of intact tumuli and fumarolic cones are evenly distributed.

Arxan UGGp has densely-distributed volcanogenic lakes, including six high crater lakes, one low crater lake (maar lake), one volcanic depression lake and six barrier lakes. Dichi, in particular, is a lake created by Hawaiian-type eruptions. This depressed flat-bottomed crater lake, created by collapsing lava, is the only one of its kind in China.

Strong Cenozoic orogenic activities created a series of fault zones in Arxan. Several stages of volcanic activity enriched the region with an extensive volcanic geoheritage and provided favourable tectonic conditions for natural springs. Groundwater flowing along the fault zones, mineralizing continuously during the process, until it emerged at the surface, forming the Arxan springs. The unique combination of volcanoes and natural springs in Arxan UGGp is fascinating and arouses great interest in discovering the natural wonders of the region.

There are four groups of natural springs in the Geopark: the Wuli Hot Springs, Arxan Sanitarium Springs, Jinjianggou Hot Springs and Yinjianggou Hot Springs. There are 76 springs in total, with temperatures ranging from 1℃ to 48℃. The coexistence of cold and hot springs as little as 0.3 m apart is globally rare. The spring water is either weakly acidic or weakly alkaline, and contains health-enhancing minerals and elements. It is potable grade mineral water. Clinically, Arxan springs have therapeutic value for diseases of the locomotive organs and the digestive system.

Because geodiversity in Arxan UGGp has a range of values in many ways and it is threatened by human activities and urban development. Geoconservation is essential for the wellbeing of the present and future generations. Geodiversity and geoconservation deserve more attentions in Arxan UGGp.

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Arxan saniatarium springs

Aso UGGp, Japan - Asia

The Geodivesity concept strengthens disaster resilience in Koki Nagata, Aso Geopark

Destroyed Districts in Nishihara Village.

Kumamoto Earthquake

Aso UGGp experienced a series of magnitude 6 and magnitude 7 earthquakes in 2016. It was the first time in Japan's recorded history that an intensity of 7 was recorded in a series of seismic activity. The Kumamoto earthquake caused significant damage, with 273 people killed and approximately 200,000 people forced to live in evacuation centres throughout Kumamoto Prefecture. Based on excavating trenches Toda et al (2019) point out the activity on the Futagawa fault that caused this earthquake may have occurred about once every 2,000 years.(Fig.3) Today, the infrastructure has been almost restored, but the impact of the earthquake remains strong in the memory of the residents and the local culture.

Anxiety immediately after the quake

Immediately after the earthquake, many residents commented, "I wondered why this happened," and "I thought there would never be a major earthquake in in Aso''. They spent their time in the elementary school where they were evacuated, frightened by aftershocks without any information about the current situation.

On the other hand, Natsuko Kodama, a Geopark staff member at the time, said "I felt this earthquake is the movement of the Earth. I had never learned about Earth science, but I naturally accepted the geological characteristics and geological processes of Aso caldera through my involvement in the Geopark programme". She said that even immediately after the earthquake, she did not panic in terms of "why did something so terrible happen? so, I I was easily able to switch my mind to recovery and how I should respond to this disaster. "

Landslide caused by earthquakes at Minami-Aso village

Futagawa fault. The vegetation attached to the rock decreases toward the left of the photo, indicating that the fault has moved repeatedly.

Geodiversity and Disaster Mitigation

This Aso UGGp staff's experience suggests that the Geopark programme and the concept of geodiversity may be able to reduce anxiety in the immediate aftermath of an earthquake. Geodiversity is a dynamic concept that not only describes the elements in of Non-Living Nature, but also encompasses its processes, and helps us understand Earth phenomena that are unlikely to be encountered in one's lifetime, such as the Kumamoto earthquake.

Therefore, Aso Geopark will continue to work on disaster mitigation using the concept of geodiversity, and create a society where there is never again the confusion and anxiety of "I can't believe this happened".

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Reference: *Toda, S., Torii, M., Okuno, M., Konno, A., Ono, H. and Takahashi, N. (2019) Evidence for Holocene paleoseismic events on the 2016 Kumamoto earthquake rupture zone within the Aso ccaldera: A trench excavation survey at Kurokawa, the town of Minami-Aso, southwest Japan. Active Fault Research, No.51, 13-25.*

Parco del Beigua, UGGp, Italy - Europe

Geodiversity meets biodiversity and culture in Beigua Geopark

The Block fields.

(Photo by Roberto Guaschino)

A Geopark with its feet in the sea. The 12 km flat walk that connects Varazze to Arenzano, can be explored on foot or by bicycle all year round, was once a railway track overlooking the sea. Here 250 million years ago there was an oceanic seabed, consisting of ophiolites, metagabbro and serpentinites, which the locals simply call gianchi (whites) and neigri (blacks).

A Geopark with its heart in the mountains. Walking along the Alta Via dei Monti Liguri, a trail with a spectacular terrace overlooking the sea, you can reach the blockfield, a vast accumulation of rocky blocks, evidence of ancient geomorphological processes. The Faiallo Pass, a stopping point along the Alta Via, is a perfect place to start a hike towards the wild Cerusa Valley, through rock pinnacles and hidden lakes. The mountains that line the the coast are well-known areas where birdwatchers can observe migrating birds heading for their nesting places.

A Geopark with an ancient history. Twenty-eight million years ago or more the local environment was very different from today. There was lush vegetation, typical of a rainforest with tree ferns, palms, magnolias and a vast sea with colourful fish, sharks and dugongs swimming in the shallows. Discover the exhibition at the Park Visitor Centre in Sassello where the small museum displays the geological evolution of the Beigua area in the Oligocene Epoch. Find the traces left in the landscape by the fossil coral reef of Maddalena in Sassello or the fossilised fern imprints at Stella Santa Giustina.

On the outskirts of the village of Sassello the Deiva Forest is crossed by a network of paths to explore either on foot, by mountain bike or on horseback, and in winter with snowshoes. It is a perfect place to admire the autumn leaf colour. Heading towards Monte Beigua you can find the Laione peat bog, a precious wetland which hosts the habitat for insectivorous plants such as *Drosera rotundifolia.*

A Geopark of contrasts. In the quiet landscape of the Tiglieto Plain lies the 900 years old Cistercian Abbey, which preserves within its walls the stories of the medieval period. Not far away you can find the wild scenery of Val Gargassa in Rossiglione where, between rough conglomerate walls, the rushing torrent has carved a deep canyon, with rugged rock forms reflected in little lakes.

In the nearby village of Campo Ligure a castle dominates the tangle of narrow alleyways and streets overlooked by many workshops producing filigree, the precious arabesques of thin threads of gold and silver.

Not to be missed, a geological treasure hidden in the Masone Valley the Snake Waterfall situated between dark green rocks, serpentinites and serpentinite schists.

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The Panorama point in Beigua Geopark.

(Photo by Roberto Guaschino)

Winter time in Beigua Geopark.

(Photo by Marco Bertolini)

Bohemian Paradise UGGp, Czechia - Europe

The Unprecedented Geodiversity of the Bohemian Paradise Geopark

Hruboskalsko Sandstone Rock Town.

The UNESCO Bohemian Paradise Geopark possesses a wide range of geological and geomorphological phenomena as well as locations with significant palaeontological, archaeological and mineralogical attributes. The Geopark is situated in an area where three different geological features meet: the Bohemian Cretaceous Basin, Železný Brod Crystalline Complex and the Krkonoše Piedmont Basin creating the remarkable diversity of the Geopark's outstanding geology and wildlife. The landscape has a rich cultural and natural heritage and is an excellent example of the influence and importance of both the natural environment and natural resources for the economic and cultural development of the local inhabitants.

Over hundreds of millions of years, the area of the Geopark was repeatedly flooded by seas and was situated at the bottom of lakes. It was also a volcanically active on several occasions. As a result of these processes a landscape full of wild rocks, volcanoes, karst phenomena, rivers, romantic valleys, forests, meadows and lakes evolved.

Trosky Volcanic Cones.

Agate.

Hruboskalské Rock Town

The most extensive rock city in the Bohemian Paradise, formed by quartz block sandstones, includes hundreds of rock massifs and individual towers that reach a height of up to 60 m. The foundations of the rock city were created in the younger Pleistocene, while the honeycombs, rock ledges, cavities and windows were created during the Holocene.

Trosky

The most famous symbol of the Bohemian Paradise. The erosional remains of a cinder cone of a volcano that was active 16.5 million years ago. Erosion has exposed the volcano's double feeding channel formed by basanite. On both peaks and between the volcanic cones lie the remains of a castle from the 14th century.

Kozákov (744 m.)

This hill is a geologically and mineralogically significant location with many outcrops on the slopes. Permian, Cretaceous and Neogene rocks contribute to its geology. The most common rocks consist of Permian andesitoids (melaphyres). Today, these are exposed mainly on the southern slope of Kozákov. In the veins and amigdales there are gem varieties of quartz (agate, jasper, chalcedony, amethyst, kasholong opal etc.). Other minerals include zeolites and calcite minerals. On the western slope, the Permian andesitoids are overlain by siliceous sandstones of the Peruc and Korycan with remains of plants and bivalve impressions. These rocks form a tectonically uplifted block. Palaeozoic dolomites are associated with remarkable pseudokarst features and archaeologically important caves. The top part of Kozákov and part of its eastern and northern slopes are made up of Neogene basalt Kozákov as a mineralogical locality was already known to artists in the early Middle Ages, when local jasper was mainly used. Ornaments and reliefs made from it can be found on artefacts in collections across Europe.

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Burren and Cliffs of Moher UGGp, Ireland - Europe

Geodiversity in the Burren and Cliffs of Moher Geopark

Burren National Park.

The Burren and Cliffs of Moher UNESCO Global Geopark (UGGp) is located in County Clare on the west coast of Ireland and is famous for its landscape formed on Carboniferous sedimentary rocks. The main area of the Geopark is dominated by large areas of exposed Lower Carboniferous (Mississippian) limestone and the extensive karst features developed on and below the limestone surface. Overlying the limestone is a thick sequence of Upper Carboniferous (Pennsylvanian) sandstones, siltstones and shales, most dramatically exposed along the world-famous Cliffs of Moher.

Doolin Cave

The area of exposed limestone is known as the Burren (meaning 'rocky place' in Irish), an area of gentle hills and valleys that have been inhabited by farmers for 6,000 years. The limestone was formed in a shallow tropical sea close to the equator 330 million years ago and is packed with fossils, including brachiopods, corals, crinoids and many microfossils. The limestones are very pure, but shale layers are present in some sections which represent soil horizons that developed during periods of exposure when sea-level fluctuated during the Carboniferous glacial period. These shale layers contribute to the formation of limestone terraces which formed by glacial plucking when the area was covered by thick ice sheets during the last glacial maximum, 21,000 years ago. One of the best places to see this is the Burren National Park Geosite.

Cliffs of Moher geosite.

Our most iconic Geosite is the Cliffs of Moher, a coastal cliff section that extends for 9km between Doolin and Hags Head. This sheer cliff section exposes gently dipping beds of sandstone, siltstone and shale which can be viewed along a coastal path all year round or from below by boat during the tourist season. The sediments of the Cliffs of Moher were originally deposited by large rivers depositing sediment offshore that formed a series of deltas. This mixing of fresh and marine water is reflected in the fossils which include a mixture of terrestrial plant material and marine organisms such as goniatites. In addition, local family-owned quarries extract Moher Flagstones which contain impressive trace fossils.

The surface and subsurface of the Burren limestone has been extensively affected by water, which dissolves limestone. This has produced a karst environment and the effect of water varies from producing small surface pits and hollows to extensive cave systems with well-developed stalactites. The presence of well-developed joints in the limestone has led to the development of clints and grikes and limestone pavement. Doolin Cave Geosite is a family-run show cave experience which has one of the longest (7m) free-hanging stalactites in Europe.

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Causses du Quercy UGGp, France - Europe

Geodiversity in Causses Geopark - a 250 million year old story

Phosphatière, phosphate cave, of Pech Crabit.

(Photo by Martin Taburet)

Resurgence of Saint Sauveur.

(Photo by Martin Taburet)

The formation of the Causses du Quercy began 250 million years ago when the Quercy was submerged under water. The accumulation of sediments led to the formation of the limestones that form the Geopark's plateau. The geological history of the Causses du Quercy contains evidence of a succession of landscapes: rocky tropical forest, tropical savannah, glacial periods to present day landscapes and finally the present day landscapes of limestone plateau and valleys. Humans arrived on the Causses du Quercy about 350,000 years ago. From prehistoric times to the present day, through the Middle Ages and the 19th century, man's passage is written here in stone. A rich heritage of stone monuments and constructions bears witness to this human occupation

The crowning glory of the Geopark, the phosphate caves provide a window into the evolution of the climate during very specific periods of the geological time scale. «Phosphate holes», exploited for a short period at the end of the 19th century. contained the fossilized bones of mammals, reptiles and birds, seeds, flowers, insects, myriapods etc. From these precious fossils, palaeontologists can recreate the disappeared world of a tropical Quercy, with both forest and savannah which was inhabited by various intriguing animals and plants. These natural cavities, once exploited by man, have revealed, through the 700 or so species of fossils discovered, a specificity that is almost unique in the world. The expression of some 30 million years of the continuous evolution of species and climate in the Causses du Quercy !

There is very little surface water on the causse. Streams on the impermeable soil infiltrate the limestone when they reach the causse. They continue their journey below ground where after travelling through the depths of the karst landscape, the subterranean streams resurface forming pools of clear water. These fascinating deep pools are known as emergences. These are much favoured by cave divers who explore the flooded underground galleries.

Because water is rare on the surface of the causse people have always sought to retain and exploit it. The «Lacs de Saint Namphaise» were excavated in the limestone of the causse to gather rainwater. They were used as drinking-places for the flocks and herds but nowadays are rarely used and are replaced by more practical portable tanks. However, they provide a habitat for a whole range of small creatures that favour damp environments and contribute to the biological diversity of the causses including salamanders, newts, dragonflies etc. Whenever water flows intermittently or permanently on the surface, mills transform the flow of water into a mechanical force, as at the Moulin du Saut mill, built on the Alzou River in the 18th century.

Mill and waterfall of the Moulin du Saut.

(Photo by Emeline Villeneuve)

The Causses du Quercy UNESCO Global Geopark aims to give everyone the opportunity to travel through time and to discover it's geological eras, civilisations and rich biodiversity.

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Chablais UGGp, France - Europe

From Great Glaciations to the Building of Mountains, Travel Through Time in the Chablais UGGp

The well-formed pillows in pillow lavas range in length from 50cm to 180cm in the Chablais UGGp. Part of an ophiolitic unit dating back to the Jurassic, these rocks are rarely preserved in the geological record. Today they are found at an elevation of 2000m – despite the fact that they were formed in the depths of an ancient ocean. (© F Tognetto).

In the Ardoisières Valley, Morzine, an important slate mining tradition continues to this day. A platy limestone (not a true slate) is worked using methods passed from father to son over generations. (© SIAC, S Justice).

The exceptional geodiversity of the Chablais UGGp is archived in 85 contrasting geosites. These chapters of Earth history recount the formation of the Alps and the last great glaciation and are intimately linked to its exceptional local flora and fauna, and rich human story.

Today's peaceful mountain summits of the southern Chablais UGGp belie their restless past. Under the slopes of one of the world's largest ski areas lie rare alpine ophiolites1 that include well preserved pillow lavas and rocks known as hyaloclastites (angular fragments of volcanic glass). The oceanic ensemble at the Tete du Vuargne is dated at more than 168 million years old and tells of the subduction of an ancient ocean and subsequent formation of the Alps.

In the Ardoisières Valley, Morzine, an important slate mining tradition continues to this day. A platy limestone (not a true slate) is worked using methods passed from father to son over generations. Most of this unit, however, bears the scars of the supercontinent Pangea being ripped apart, around 190 million years ago. Sporadic earthquakes accompanied the formation of the rift and caused its underwater cliffs to collapse. Clearly visible to the naked eye, this jumbled, angular debris is today frozen into distinctive new units, the Lower and Upper Breccia.

The economic activity of the Chablais is strongly influenced by the Wurm glaciation (60 000 – 12 000 years ago). A great stretch of golden sand marks the popular tourist beach of Excenevex, the only natural sandy beach on the 200km shoreline of Lake Geneva. Rare continental hydraulic-aeolian dune processes are driven by a prevailing wind (the Bise), which remobilises glacial deposits in the lake. Variations in the lake level expose subaquatic dunes, that then migrate onshore. An area of hydraulic and fossil dunes is protected as an important Natura 2000 Habitat site.

Lake Vallon, Bellevaux is a new feature in the landscape formed by a large, slow-moving mudflow that damned the River Brevon. Today the foundations of destroyed buildings and drowned trees are exposed in the lake. (© SIAC, – A. Berger).

Internationally renowned for its mineral water, the Evian spa town has been bestowed with a great natural gift: an extraordinary layered glacial sedimentary sequence over 400m thick. Sealed by thick impermeable clays at its upper and lower surfaces that maintain its quality, water slowly permeates through the unit where it is filtered and mineralised. Since 1992 local municipalities, the evian® company and local stakeholders have worked together to preserve the water resources

Landscapes continue to evolve, sometimes in an abrupt manner. On the night of 11th March 1943, a landslip caused by heavy rain and unstable bedrock cause a huge mudslide that damned the River Brevon, forming Lake Vallon. This natural disaster forced numerous families to hurriedly pack their belongings, dismantle their wooden houses and relocate their businesses. Dramatic black and white footage of the incident was the main story on the national news in wartime France. Traces remain in the landscape to this day that include the submerged foundations of farm buildings.

Sophie Justice

Chelmos Vouraikos UGGp, Greece - Europe

The rocks, the mountains and the myths…

Geosite Cave of the Lakes. Photo from the touristic part of the cave. It is decorated with stalagmites, curtains and gours that form an extraordinary landform.

Vouraikos Gorge at Geosite Portes-Triklia, which according to mythology Hercules himself was responsible for its creation. The famous Odontotos rack railway crosses the steep slopes of the limestone in the gorge which have been uplifted by tectonic movements and sculptured by river erosion.

Chelmos Vouraikos is located in the North Peloponnesus, Greece and occupies an area of 647 km^2. Its inhabitants, with no more than 27,000 people, live in small towns and villages in between high mountain peaks and deep river gorges!

The Geopark area has a rich geoheritage represented by various rock types that formed during eight different geologic periods and describe the story of the Earth's development through time, especially the internal and external processes that have shaped the Earth. Within the territory of the Geopark 40 geosites have been designated to-date. All of them are publicly interpreted and used for geotourism. Nineteen of them have been acknowledged to be of scientific importance and 12 are used for educational purposes. Additionally, nine are of internationally recognized value (SCI and SPA areas). In the Geopark's territory there are also several sites of archaeological, natural and cultural interest which are included in the Geopark's catalogue of sites of interest.

The story begins 485 million years ago, when the area was covered by the sea, where sedimentary rocks were formed (mostly limestones). With the passing of time, tectonic compression resulted in uplift. Chelmos Mountain emerged, revealing a wide variety of geomorphological features (caves, poljes, sinkholes, moraines, cirques, alpine lakes, steep slopes and waterfalls) which tell the story of the Earth.

The Feneos polje surface drainage is captured by three solution sinkholes created through suffusion processes. The sinkholes are a few metres wide and are connected with ancient Greek mythology. This pinpoints their diachronic importance for the landscape and their connection to the local community.

The famous geosite Cave of the Lakes, developed along a NW-SE oriented fault line. from the rich and impressive speleothems found in part of the cave, the most impressive feature is the presence of 13 successive and terraced underground lakes located at different levels, that were formed due to the slow flow and stagnation of water, resulting in the formation of calcite walls (gours or rimstones) which are still growing. Excavations that occurred in the first section of the cave found rich archaeological and palaeoanthropological remains of Neolithic age showing that the cave was inhabited since 5650 BC.

Mt Chelmos is another part of the Geopark with significant geodiversity that also displays several landforms characteristic of extensive past glaciation. At least three Middle to Late Pleistocene glacial phases can be identified from the different landforms, distributed radially around the highest peaks (Psili Corfi and Neraidorachi geosites) and tell the story of when the Earth was much cooler.

While uplift created mountains, erosion reduced them! In this way the spectacular Vouraikos Gorge was formed It combines ideally the wild beauty of the landscape, the rich geodiversity and the unique biodiversity. The historic Odontotos rack railway "climbs" the gorge, offering the visitor a different perspective of the natural heritage of the area.

The intense geomorphology excited the imagination of our ancestors who left us a great mythological legacy! Hercules was wondering around the area '"digging" sinkholes in Feneos polje and "cutting" gorges (geosite Portes-Triklia-Vouraikos gorge) and Achilles became immortal in the waters of Styx waterfall, except for his heel of course !

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Colca and Andagua volcanoes UGGp, Perú - S. America

Geodiversity highlights in Colca de Andagua Geopark

Volcanoes in Andagua Valley.

Mismi Mountain, origin and headwaters of the Amazon River.

Andagua Volcanoes Valley. A Group of monogenetic volcanoes that extends into the Orcopampa/Andagua Valley, Arequipa, southern Perú. Fiftyfive kilometres of lava fields from the Upper Pleistocene, Holocene and the historical epoch. Scoria and cinder cones, dark basaltic lava flows, fissure lavas and lava domes fill a river valley forming canyons, waterfalls and lagoons.

Complex structures in Jurassic strata of Sucna Hill. Complex chevron folds and faults in Jurassic grey sandstone and black shale strata of the Puente Formation, near the mouth of the Mamacocha River in the Colca River Canyon, a didactic example of the multiple tectonic phases of the Andean orogeny.

Mismi Mountain, sacred mountain and source and headwaters of the Amazon River. A volcanic structure formed during the Mio-Pliocene (12-3 million years ago), where the Mismi snowy mountain (5,597 m above sea level) stands out as part of the Chila mountain range, and creates a drainage divide. The thaw of ice and snow on the North Slope created the Apacheta ravine, part of a network that contributes to the Amazon River, flowing towards the Atlantic Ocean traveling 7,100 km and making it the longest river on the planet. The snow melt also allows the development of agriculture on the right bank of the Colca, a sacred mountain revered by the Collagua culture to this day.

Landslides in Colca Valley on palaeolake deposits from 600 thousand years ago. Lacustrine sediments of the Colca Formation, deposited in a "palaeolake", formed due to the closure caused by the collapse of the northern flank of the Hualca Hualca volcano approximately 600 thousand years ago. Populations on both margins of the valley created pre-Hispanic agricultural platforms and roads and settled on these deposits. Madrigal, Lari, Maca, Achoma, Ichupampa and Yanque, are affected by landslides, such as the landslide that recently occurred in the year 2020 in Achoma that affected platforms and the tourist infrastructure.

Landslides in Colca Valley.

Colca Canyon. The canyon section of the Colca River in the Central Andes, south of the Nasca ridge, southern Perú is 100 km in length, has a difference in altitude of 1,800 m and mountain ecosystems between altitudes of 2,950 m and 1,150 m. It cuts through Proterozoic metamorphic basement rocks. Upper Jurassic-Cretaceous sedimentary sequences, fossiliferous deposits and Palaeogene-Neogene volcanic and intrusive rocks. This is a geologically active zone with folds and faults associated with Andean Tectonics, strato volcanoes, lava fields and Plio-quaternary monogenetic cones formed during the last two million years., active neotectonic faults, hot springs and impressive landscapes.

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Cuilcagh Lakelands UGGp, Ireland / UK - Europe

Cuilcagh Lakelands UNESCO Global Geopark: almost one billion years in the making

Cuilcagh Mountain: Offering a near complete sequence of Carboniferous-age sedimentary rocks of the Leitrim Group spanning over 8 million years, Cuilcagh Mountain provides excellent opportunities for studying a great variety of depositional settings including marine, supratidal and deltaic environments.

The Cuilcagh Lakelands UGGp has nearly 900 million years of geological history and charts the journey of the island of Ireland, from its location as a divided landmass on two separate continents in the southern hemisphere, to its present absolute location at approximately 54°N. The varied landscapes of the Cuilcagh Lakelands UGGp are an expression of the area's diverse geological history in an unspoilt corner of the Irish countryside, with the most significant geological highlights presented below.

The area is dominated by its Carboniferous geology, consisting of sedimentary rocks of late Visean to early Namurian age deposited in a wide range of marine, supratidal and deltaic environments. The horizontal stratigraphy underlies the upland areas of Cuilcagh Lakelands UGGp, now dissected by glacially-carved valleys leaving behind plateau-topped mountains and hills. The highest point of these is Cuilcagh Mountain at 665m, with a near complete sequence of the Carboniferous Leitrim Group spanning over 8 million years. This is one of very few exposures of this age that display such a wide variety of lithologies and fossil assemblages. The numerous exposures provide outstanding examples on which to base the principles of, and on which to demonstrate the interaction between litho- and biostratigraphy.

Cuilcagh Lakelands UGGp is best known for its Carboniferous limestone. Its presence has led to the development of an extensive upland karst with glacially modified karst, pre- and postglacial karst, surface and underground karstification, and complex hydrological catchments. The Marble Arch cave system and the associated karst in its catchment are widely regarded as one of the finest examples of a mature karst landscape in the UK and Ireland with a catchment of approximately 27km², and over 10km of explored passageways.

Lough Oughter: The geomorphology of Lough Oughter is located within an area of ribbed moraines that contains some of the largest ribbed moraines in the world.

Although rarely seen at the surface, Palaeogene dykes have had a profound impact on the hydrology of the area and are an important part of the geological heritage associated with the opening of the North Atlantic in the early Palaeogene Period. One of these dykes, the Cuilcagh Dyke, is unique in Ireland in having both normal and reverse magnetic polarity anomalies. The Kingscourt-Donegal dyke swarm and the smaller Erne dyke swarm form part of the much larger North Atlantic Palaeogene Igneous Province.

The bedrock that makes up the Cuilcagh Lakelands UGGp was sculpted and moulded during the Quaternary Period by repeated glaciations. These are responsible for both erosive and depositional glacial landforms including u-shaped valleys, drumlins and glacial erratics. Some of the most important glacial features, however, are seen at Lough Oughter set within a field of ribbed moraines. The entire field includes over 3,000 glacial features, but this subset covers an area of 180Km², containing approximately 160 individual features, and includes some of the largest individual ribbed moraines found anywhere in the world

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Marlbank: The Marlbank consists predominantly of limestone hills with a limestone escarpment. The topography is especially notable, reflecting the Carboniferous sea floor on which the limestone formed, with the hills representing 340 million year old mud mounds.

Djerdap UGGp, Serbia - Europe

The Danube flows through the Iron Gate tn the Djerdap Geopark

Kladušnica terrace – river terrace sediments, one of the incision phases of the Danube River in the Southern Carpathians' rim.

The geodiversity of the Djerdap Geopark area is very diverse and apart from geological sites, there are also morphological features, dominated by the Djerdap gorge, the longest elbow in Europe. The Djerdap gorge stretches from the Fortress "Golubački grad" downstream of the Danube to Kladovo, over a distance of of 117 km. Morphologic features of Djerdap indicate that the Danube formed the gorge during a long period of continuous erosion and downcutting into the mountain massif of the Carpathians. Along the gorge, the remains of a succession of river terraces mark nine stages in the downcutting process. The youngest river terrace is located near Kladušnica and is a geoheritage site.

Tectonic events in the region, which is part of the Carpathian arc, are reflected in the recent structural pattern and numerous longitudinal structural zones. Two ranges of nappes, named Gheticum and Krainicum, are the outstanding tectonic structures. The Homolje crystalline massif, Poreč and Miroč units are three minor structures.

The oldest rocks are found in the crystalline massif of Homolje which is composed of two Proterozoic rock complexes. The lower complex consists of plagioclase gneisses tectonically and erosionally covered by different schists. The Miroč unit also contains chloritic/sericitic and actinolitic schists, and Precambrian to Ordovician gabbros. These are transgressively overlain by Silurian/Devonian sandstones, argillaceous schists and limestones exceeding 250 metres in thickness and Lower Carboniferous limestones and conglomerates including porphyries and rhyolite. Near Brnjica, the Palaeozoic complex is broken by a large mass of granite and granodiorite, which has been exploited for almost a century. In the area of Left River, there are outcrops of black phyllites of Carboniferous age, which are of scientific importance for the study of the Palaeozoic complex of the southern Carpathians. The Palaeozoic complex terminates in Permian red sandstones that extend as a narrow zone along Poreč Bay and upstream, along the left bank of the Poreč River. The Permian red sandstones are overlain by Liassic limestones with alternating flaggy and cherty limestones and marls with an abundance of ammonites.

Cave Gradašnica - It stands out for the depth of light penetration from the entrance (almost 125 m) and, the accumulation of amorphous silica - the first discovery in Serbia.

Within the Djerdap Geopark, the geomorphology is varied and characterized by features created by fluvial and karst denudation. Djerdap consists of four gorges: Golubac Gorge, Gospodjin Vir with Boljetinska River Canyon, the most attractive geoheritage site, and Kazan and Sip Gorges. Geomorphological sites of particular interest are Veliki Štrbac, Mali Kazan and Veliki Kazan where the Danube is at its narrowest (150 m) and deepest (about 90 m).

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El Hierro UGGp, Spain - Europe

The Geodiversity of El Hierro Geopark

Los Negros Beach Cliffs.A basaltic pyroclastic cone with its feeding dike sectioned by the cliff.

Over 1.2 million years ago, the Island of El Hierro emerged from the ocean after a long history of submarine growth on the surface of the oceanic crust of the African plate. There have been five volcanic edifices in its history: Tiñor, El Golfo-Las Playas and the three ridges or rifts.

The instability of the El Golfo-Las Playas volcanic edifice and the rifts, due mainly to its excessive growth and the accumulation of volcanic material, initiated gravitational mega-landslides that produced large deposits of rocky avalanches on the ocean floor. As a result, the island has three impressive amphitheater like escarpments which are open to the ocean. Examples can be seen in the majestic valley of El Golfo, in the Las Playas arch or in the Julan arch, partially filled by strongly inclined sediments, pyroclasts and lava flows due to subsequent volcanic activity that sometimes formed volcanoes such as Tanganasoga. The presence of these three amphitheaters at the junction between each two of these three ridges gives rise to the characteristic three-sided pyramid shape of the Island of El Hierro.

One of the most interesting structures is the San Andreas Fault. This fault, and other related faults, with polished, smooth and striated surfaces, are the geological vestige of an event that occurred hundreds of thousands of years ago, when the southeastern flank of the island began to slide without becoming completely detached. The mark of this drastic process is recorded in the morphology of the land.

In the escarpments produced by these landslides and in the sea cliffs, we can observe numerous cross-sections through pyroclastic cones. These are split in half, with their feeding dike exposed, which allows us to see at a glance the internal structure of these small volcanoes.

But, one of the most extraordinary features that the El Hierro Geopark treasures are its spectacular lava fields. Some are formed by thin sheets of lava, with smooth surfaces or with deep wrinkles and folds. Here the flowing lava produced incredible organic forms of ropes, strings or guts, which are rightly nicknamed "corded lavas" or "guts".

These very fluid lavas, extruded from fissures and "hornitos"at high temperatures, could travel over distances of several kilometres.

In these landscapes of unusual beauty, we can also find channels through which we now imagine the flow of lava or remains of volcanic tubes, some of which are well preserved and accessible to visitors.

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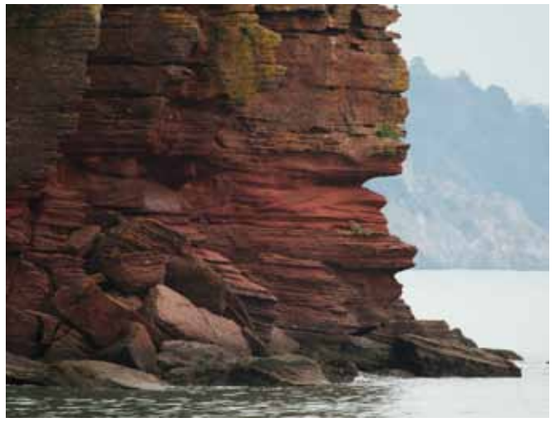
El Golfo Valley. An amphitheater formed by a mega-landslide.

El Lajial. Pahoehoe lava field.

English Riviera UGGp, UK - Europe

From geological pioneers to UNESCO Global Geopark recognition

Folding at Orestone off Hopes Nose.



Permian deposits Roundam Head SSSI

(Photo by Chris Proctor).

Unique in Western Europe, the English Riviera UNESCO Global Geopark (ERUGGp) is geologically renowned for its marine Devonian limestones, which are of great historical importance. The rich faunas yielded by these rocks were used, in part, to characterise the original Devonian System of the pioneering geologists Adam Sedgwick and Roderick Murchison. Later, deformed during the Variscan Orogeny, the limestones today form a dramatic and intricate coastline with the two headlands of Berry Head and Hopes Nose creating the sheltered environment of Tor Bay. In addition, excellent exposures of classic, softer, desert sandstone and breccia in the Permian 'Red Bed' sequences are present around the inner area of the bay creating a juxtaposition of both deep time and habitats.

The marine Devonian limestones also include important Quaternary karst features such as bone caves, which provide one of the longest records of Pleistocene events not only in South-West England but also in Western Europe. With three species, *Homo heidelbergensis*, followed by neanderthals and *Homo sapiens* found during the excavations, the caves were central to the pioneering work carried out in the nineteenth century and subsequent controversies about the antiquity of human beings. There are only two caves in the World where three or more different species of humans are found, and only one is a show cave; a cave open to the general public, and that is Kents Cavern in the ERUGGp.

Exploring Kents Cavern.

Whilst very few raised beach localities elsewhere in Britain have revealed so much palaeoenvironmental information as those in the ERUGGp, the juxtaposition of raised beaches and drowned forests provides important information about Pleistocene climate change.

The limestones have also created a range of habitats supporting plant communities and mammal species, both marine and terrestrial, of national and international importance. The shape of Tor Bay, which is controlled by the underlying geology, is also a designated Marine Conservation Zone with nationally important sea grass meadows.

In essence, the English Riviera UNESCO Global Geopark is a superb geological resource, covering 400 million years of geological time all within a compact area, leading to one of the highest concentrations of designated sites in the UK. A considerable scientific literature exists describing all aspects of the geology, much of which is historical, dating from the early nineteenth century. Crucially, however, the area was re-surveyed by the British Geological Survey and the publication of a new geological map has been accompanied by a booklet describing the area (Geology of the Torquay district, BGS, 2003).

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Grevena - Kozani UGGp, Greece - Europe

Geodiversity in Geopark Grevena-Kozani

The Vourinos Ophiolite (middle-Jurassic), a remnant of the Tethys oceanic crust.

The geologic history of the Geopark Grevena-Kozani spans a billion years. Its oldest rocks are the oldest in Greece and include granodiorites and their metasedimentary hosts that were formed within the ancient Amazonian Craton. These merged into the greater continent of Pangea along with proto-continents of Europe and Africa ~ 300 million years ago. The rifting of Pangea (~250 million years ago in the mid-Triassic) is shown within rock formations of the Geopark. These include early oceanic abyssal cherts and manganese-rich carbonate, and volcanic ash. Continued rifting created the new Tethyan Ocean tectonic plate. The Tethys crust is preserved as the Vourinos Ophiolite (middle-Jurassic). This contains a complete lithospheric section extending from peridotite rocks of the upper mantle, through ocean crust magma chambers, the dike swarms which fed the sub-marine volcanoes at the oceanic spreading centre, and the overlying sediment-covered, ocean floor. The Vourinos Ophiolite was emplaced over the European tectonic plate in the late Jurassic. During the time interval leading to our recent past, the subsurface movement of these tectonic plates created the mountainous regions of the Pindos These show scarring by glaciers in the ice ages, together with the formation of peri-glacial lakes and cataclysmic canyons throughout the terrain of the Geopark. Some of the youngest rocks in Greece include formations of colluvial deposits and palaeosols, some of which were partially buried and partially eroded creating "hoodoo" rock spires.

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Eroded palaeosols with hoodoo spires capped by less easily eroded rocks.

The suture that marks the collision between the Tethys plate with the European plate and the death of the Tethys Ocean.

The Holy Cross Mountains UGGp, Poland - Europe

From the Cambrian sea to the lowest mountains in the Holy Cross Mountains Geopark

Rugose coral from Upper Devonian of Wietrznia geosite.

(Photo by J. Jedrychowski).

The geological history of the Świętokrzyski (Holy Cross Mts.) UNESCO Global Geopark,Poland, recorded in the sedimentary rocks and fossils, dates back almost 540 million years. This story began at the bottom of the Cambrian sea and its subsequent chapters took place in the sea and land environments of later geological periods, up to the Quaternary. A particularly rich geological record is associated with the Devonian. It was during this period of the Earth's history that the area of today's Holy Cross Mountains (including the Holy Cross Mts. UGGp) was located in the equatorial zone, on the shelf of the Laurussia continent, occupied by a shallow tropical sea. Huge masses of sediment mixed with the remains of thermophilic reef organisms gave rise to thick layers of limestone rich in fossils. These rocks are now perfectly visible in many geosites, especially in the former quarries (Kadzielnia, Wietrznia, Chęciny, Bolechowice) situated in the northern and central part of the Geopark. The history of the post-Devonian rock formations is also fascinating. The orogenic movements and subsequent terrestrial periods in the geological history of the Geopark have left a record in the form of various structures and phenomena. Tectonic folds and faults, hydrothermal mineralization as well as coarse-grained sedimentary rocks from denuded mountain ranges, testify to the eventful past of this area, especially during the Late Carboniferous and Late Cretaceous. A unique record of these phenomena can be seen in many geosites in the Geopark's territory, including: Miedzianka, Zelejowa, Czerwona Góra, Chelosiowa Jama and Ślichowice. Numerous karst forms, including caves, testify to the intensive dissolution of carbonate rocks by water in the subtropical climate of the Permian, Triassic, Palaeogene and Neogene. If you want to experience emotions in communing with the underground world, it is best to visit the Raj (Paradise) Cave, considered one of the most beautiful caves in Poland. The richness and variety of the dripstones in this cave delight every visitor. The clayey deposits in the Paradise Cave contain a unique record of the ice age. It is from here that the remains of two Neanderthal encampments dating back 50,000 years have been described. This brings us to the last chapter in the history of the Geopark, in which the relationship between humans and nature developed. This relationship is recorded in the form of stone tools and numerous remains of historical ore mining and quarrying. The material testimony of this history contains numerous examples of the use of rocks in the local architecture, in particular the Zamkowa Hill with the ruins of a medieval castle in Chęciny, which is the cultural and landscape symbol of the Geopark.

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The Paradise Cave geosite.

(Photo by Ł. Zarzycki)

Ślichowice geosite a former quarry with exposures of folded Devonian rocks.

(Photo by M. Poros).

Hong Kong UGGp, China - Asia

Spectacular rhyolitic columnar rock formation of Hong Kong Geopark

Photograph showing the typical geomorphological feature of the High Island Formation. The hexagonal rock columns are well exposed along the long meandering coastlines and numerous islands. The shores at High Island are rimmed with steep sea cliffs. At some sites, the columns stand up to 100m above sea level.

At High Island Reservoir East Dam, the hexagonal columns display a combination of geological features and interesting geological stories, where the S-shaped deformation was intruded by a mafic dyke

Rock columns elsewhere in the world are usually composed of dark grey basalt with low silica content. In contrast, the columnar rock formation of Hong Kong UNESCO Global Geopark, called the High Island Formation, is composed of light-coloured, silica-rich, rhyolitic volcanic rock with an up to 76% silica content. The columns are mainly pentagonal or hexagonal, estimated to cover an area of over 100 km² (including submerged areas), with an exposed height up to 100 m, a total thickness of 400 m, and an average diameter of 1.2 m, with the largest specimens measuring 3 m.

The formation is the relic of an early Cretaceous supervolcano which produced a massive amount of volcanic material. Columnar joints were developed by thermal contraction in the volcanic materials deposited within the caldera.

Widely exposed along the long meandering coastlines and numerous islands in the east part of Hong Kong, this formation is integrated with diverse coastal erosion landforms, such as sea cliffs, sea notches, sea caves and sea arches. Together, they make up Hong Kong UNESCO Global Geopark's most iconic geomorphological landscapes and world-class geo-wonders.

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With no natural barriers to offer protection, the east-facing coasts and islands meeting the sea fall victim to persistent wind and wave erosion. In this setting, the hexagonal rock columns are typically exposed in their true glory integrated with a wide range of coastal erosion landforms and breath-taking vistas.

Huanggang Dabieshan UGGp, China - Asia

Magnificent Geosites within Huanggang Dabieshan Geopark

Danxia (conglomerate and sandstone) Landform in Jiulongshan.

(Photo by Hu Zhengping).

Huanggang Dabieshan UESCO Global Geopark (Huanggang Dabieshan UGGp), with an area of 2,625.54 km², is situated on the north bank of the Yangtze River to the northeast of Hubei Province, China.

With abundant geosites, Huanggang Dabieshan UGGp contains not only a Precambrian metamorphic stratigraphic sequence, the oldest metamorphic rocks (Neoarchean basement metamorphic rock series from 2,800 million years ago) and other sedimentary and magmatic rocks, but also some tectonic sites with folds, faults and joints formed by crustal movement and plate subduction. Moreover, it harbours towering mountains formed by orogenic movement and uplift of the Earth's crust, and granite landforms of mountains, peaks and canyons formed by weathering and denudation, water erosion and gravitational collapse, all of which make Huanggang Dabieshan UGGp a field textbook and natural laboratory for the study of the Central Orogenic Belt of China.

Huangtuling, ancient continental nucleus, with an outcrop area of 10 m², belongs to the Neoarchean 2,800 million year old hypersthene garnet biotite gneiss. As a type of metamorphic rock, the rock mass, which is commonly known as the Root of Dabie Mountain, is the key to the early evolutionary history of the Earth and is of great scientific value.

The TTG rock series, which are composed of tonalite (T), trondhjemite (T) and granodiorite (G), represents the abyssal and intrusive granitic complex of an ancient continental nucleus 2,500 million years ago. The origin and cause of the TTG rock series are of great significance in understanding the evolution, accretion and reconstruction of the Earth's crust.

Eclogite is a kind of metamorphic rock formed within an ultrahigh pressure environment between 2.0 - 3.0 GPa (gigapascals). The rocks are composed mainly of garnet and omphacite, coesite and micro diamonds. It is the product of subduction during the collision of the North China Plate and Yangtze Plate during the Indonesian period 257-205 million years ago.

Muzidian (rock) Formation - Basic ultrabasic rocks, the combination of oceanic crustal material below the greenstone belt, is the product of syn-sedimentary igneous rock intrusion during the formation of the the greenstone belt. The rock is mainly amphibolite, the centres of some components consist of amphibole pyroxenite or pyroxenite. Epidotization is is a common process and adamellite of the Shengli gneissic granite suite is widely distributed in this setting. With strong migmatization, banded migmatite generally occurs interlaminated with a mass of granite or felsic veins, a small amount of pyrite appears in a fractured lattice.

Mesozoic granites are well developed in Huanggang Dabieshan UGGp. There are significant geomorphological landforms associated with the Yanshanian granite, and granite landforms featuring mountains, peaks and canyons. The typical granite landforms can be seen in the Tiantangzhai, Bodaofeng, Guifengshan mountain peaks.

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Guifengshan Sone Tortoise.

(Photo by Yang Jinzhou)

Longtan Gorge.

(Photo by Shu Shengqian)

Karawanken-Karavanke UGGp, Austria & Slovenia - Europe

Geodiversity highlights in the crossborder Karawanken-Karavanke Geopark

Obir dripstone caves in the Municiplaity of Bad Eisenkappel/ Železna Kapla are among the most beautiful natural cave systems in Austria. Twelve caves extend over a length of approximately 5 km and were discovered completely by chance during lead and zinc ore excavation in the past.

The Mežica lead and zinc mine was one of the last lead-zinc mines in Europe that was still operating at the end of the 20th century. Today the mining heritage here can be discovered by train, bike or even kayak.

The Karawanken-Karavanke UNESCO Global Geopark is a crossborder Geopark, located between Austria and Slovenia. It includes 14 municipalities, 5 Slovenian and 9 Austrian, and extends over an area of 1,067 km² with a population of 53,000 residents. In March 2013 Geopark Karawanken/Karavanke became the 54th member of the European Geopark Network (EGN). Its area is built up of an exceptional variety of sedimentary, igneous and metamorphic rocks from Ordovician to Miocene in age, which were formed during late Caledonian, Variscian and Alpine orogenic cycles over a time span of more than 450 million years. Exceptional minerals were the basis for the development of mining in the Mežica (SLO) and Obir (AT) area, and thus also for the rich natural, cultural and technological heritage. Among the geological features of the Karawanken-Karavanke UNESCO Global Geopark, the following are outstanding:

- The deposit of Carnian crinoids in the valley of the Helena stream (Črna na Koroškem), which is one of the three richest deposits of such fossils in Europe.
- The Mežica mine, one of five areas with lead and zinc ores of this type in the world, where heritage today can be discovered by a train into the mine, by bike or kayak.
- Deposits of the mineral Wulfenite in Mežica mine, which is the richest deposit in Europe and one of the best known in the world.
- The Topla zinc and lead mine (Črna na Koroškem), which is an important global example of the sedimentary formation of these ores in a supratidal sea.
- The classic deposit "locus typicus" of the mineral Dravite (brown tourmaline) in Dobrova pri Dravogradu, one of the five most important deposits in the world.
- The Periadriatic fault system, one of the most important elements in the collision between the Adriatic lithospheric microplate and the Eurasian lithospheric plate.
- The Obir Dripstone Caves (Bad Eisenkappel/Železna Kapla), the most beautiful natural dripstone caves in Austria, which were discovered completely by chance while excavating lead and zinc ore.
- The slopes of dark-grey pillow lava in the Obir Gorge (Bad Eisenkappel/Železna Kapla) and volcanic rocks at Smrekovec (Črna na Koroškem), which are proof of former volcanic activity in the area.
- The numerous mineral water springs in the area of the fault zone between Jezersko (Seeberg) and Bad Eisenkappel/ Železna Kapla.
- Wildensteiner Waterfall in Gallizien, which is one of the highest free-falling waterfalls in Europe which also features red limestone rich in ammonite aptychi, remains of echinoderms and other fossils.
- The coal mine in Leše (Prevalje), one of the largest and most modern coal mines of the time in Slovenia, which exported coal to the most important ironworks in Europe.

The 54 m Wildenstein Waterfall in the Municipality of Gallizien is one of the highest free-falling waterfalls in Europe.

The most important objective of the Karawanken-Karavanke UNESCO Global Geopark is the conservation of listed and other geological and natural resources, in the territory of 14 municipalities, the promotion and interpretation of the exceptional natural and cultural heritage.

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Katla UGGp, Iceland - Europe

Drumbabót Geosite

Tree stumps at Drumbabót. Most of the stumps still have some bark preserved at the base, but the upper part of the stumps is already eroding away.

The Drumbabót geosite is a remarkable geosite in Katla Geopark that not many are aware of. At first glance, the geosite looks just like a normal, sandy, riverbank. Once you have a closer look, however, the magic of this place comes to light, and one of the most important geoheritage sites in Iceland is revealed. The site itself was exposed in 1990, when erosion caused by flooding in the River Þverá revealed numerous, well preserved tree stumps.

The area where the stumps are found covers about 25 hectares and all the stumps that have been studied are examples of birch trees *(Betula pubescens).* They all tilt slightly towards the west or south-west, but are unbroken, and the bark on many of the trees is remarkably well preserved with no observable damage. The trees are believed to have been about 60-100 years of age when they died.

Three volcanic systems are close to the site, Tindfjallajökull to the north-east, Katla to the east and Eyjafjallajökull to the south-east. All three systems have an ice-covered central volcano that can cause a glacial outburst flood (jökulhlaup) during sub-glacial eruptions. At least eleven glacial outburst floods are known to have crossed the area and the youngest of these floods is believed to have caused the destruction of the birch woodland. The flooding probably caused a rise in the groundwater table, ultimately drowning the birch trees since their roots cannot survive submerged in water. Analysis of the sediments transported by the flood indicate that it originated from Katla Volcano.

The exact year when the trees died has recently been identified by using dendrochronology. In the year 775 there was a large solar flare that caused an increase in tree growth, identifiable in the tree-rings of the stumps found at Drumbabót. The year that the trees died, 822-823 AD, can be calculated from the number of tree-rings found in the stumps. C-14 dating of both the soil layer and the stumps and evidence from ice cores from Greenland have yielded similar results.

The uniqueness and preservation of Drumbabót is clearly remarkable, and thus the geoheritage value of the site is very high as it is the only known palaeo-forest in Iceland to have been destroyed by a glacial outburst flood. The protection of the site itself is, however, a challenge. Firstly, due to events that lead to erosion, such as weather, wind, migrating river paths and flooding, and secondly due to pressure from tourism. The Geopark, along with other agencies in Iceland and the landowners, are working on further legal protection for the site which will hopefully lead to better preservation of the site for future generations and contribute to the understanding of this remarkable geosite.

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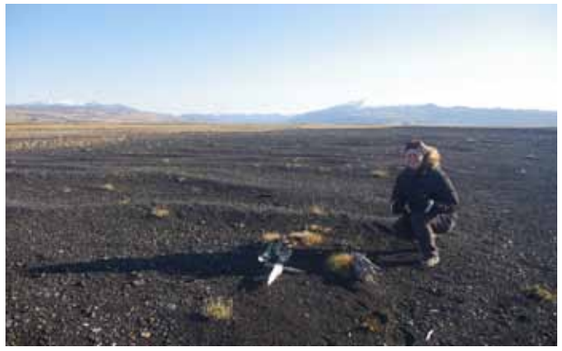
A tree stump at Drumbabót. The well-preserved bark, which was recently unearthed, can be seen. The upper part of the stump has started to weather away. 6 cm lens cap for scale.



Berglind Sigmundsdóttir, Manager of Katla Geopark, next to two tree stumps at Drumbabót, which show the direction of the flood water that killed the forest. In the distance, the three volcanic systems of Tindfjallajökull (distant left), Katla (distant centre), and Eyjafjallajökull (distant right). The large sand ripples that form in the area can be seen as well, with wind erosion exposing more of the stumps.

Kütralkura UGGp, Chile - S. America

The geodiversity of the Kütralkura Geopark sustains touristic and educational activities about the geological evolution of Southern Andes

Eroded ignimbrite deposits of the Mitrauquen Formation (9 million years old) located in the Lonquimay.

(Photo by Juan Carlos Gedda)

Lonquimay (rigth) and Tolhuaca (left) volcanoes behind mountains with Araucaria araucana trees growing in the high altitudes.

(Photo by Vicente Rosati)

The Kütralkura UNESCO Global Geopark (UGGp) is located in southern Chile, in the Araucania Region, and is characterized by its great geodiversity set in a mountain environment. The subduction of the Nazca oceanic plate under the continental South American Plate generates the formation of the Andes mountain range and a chain of active volcanoes associated with a large fault zone known as Liquiñe-Ofqui. This fault zone produces north-south oriented valleys that were eroded by glaciers that reached their maximum extensions approximately 20,000 years ago. In these valleys, there are numerous hydrothermal sources, several of which have tourist infrastructure. Glaciers can be seen on the high peaks of the volcanoes.

The geodiversity of the Kütralkura UGGp records intense and relatively continuous magmatic activity from 300 million years ago. Periods of greater activity are recognized during the Jurassic-Cretaceous, and from the Miocene to the present. In addition, deposits from Jurassic ancient marine basins are found close to a volcanic arc. The geological record of the Miocene together with fossils present show the existence of a coastal marine environment to the west and lacustrine basins to the east.

The most recent geological record of the territory includes various volcanic deposits from the Lonquimay, Llaima, Sollipulli, Quetrupillán and Lanín volcanoes. Some huge eruptions produced ignimbrites that covered large areas of the territory.

This fascinating geological history is recorded in more than 100 geosites, which are distributed over an area of more than 12,000 km^2. Most of these sites of geological interest can be found on the website www.kutralkura.cl. The presented scientific information is the result of collaborative work between local guides and professionals specializing in the natural and cultural heritage. Additionally, on this platform you can view general information about the GMU Kütralkura, along with the wide variety of geotourist products offered in the territory. The geodiversity of this Geopark supports various educational activities related to geological hazards and climate change.

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Llaima volcano located at the Conguillio National Park in the center of the Kütralkura UGGp. It has a height of 3,215 meters above sea level and is considered the second most active in the country.

(Photo by Gabriel Aravena)

Lauhanvuori - Hämeenkangas UGGp, Finland - Europe

A geodiversity hot spot in Lauhanvuori - Hämeenkangas Geopark

Lauhanvuori sandstone forms large boulder fields in the perimeter of the formation.

(Photo by Sannamari Ratilainen / Metsähallitus).

Lauhanvuori hill in Western Finland is an area of high geodiversity. The hill, rising 231 m above sea level, is one of the few inselbergs in the Fennoscandian shield and it hosts a wide range of geological formations within an area of approximately. 60 km². The geodiversity is, however,veiled by the size of the area and the nature of the formations. Lauhanvuori has been protected as a National Park since 1982 largely due to its geological diversity.

The bedrock in Lauhanvuori consists of a 1.9-billion-year-old porphyritic granite, representing the deep roots of the ancient Svecofennian mountain range. The intrusion is one of the largest Svecofennian granite intrusions. The surface of the granite is deeply weathered, and fresh rock can mainly be seen in the tors on lower parts of the hill. Much of the 10 km thick weathering and erosion occurred during Proterozoic times and the land surface level in the lower part of the hill represents the Sub-Cambrian peneplane.

The bedrock is covered by a sandstone formation with a maximum thickness of several tens of metres. Trace fossil evidence suggests an Ediacaran maximum age, but a reliable minimum age is yet to be established. Only a few outcrops of the sandstone are known. However, boulder fields situated in the perimeter of the sandstone layer provide excellent exposures of the rock and associated sedimentary structures. The Sandstone of Lauhanvuori was used as raw material in the millstone industry in the 19th century.

Above the sandstone lies a several tens of metres thick Quaternary soil with layers representing several glacial events during the Pleistocene. The surface below the highest Post-Glacial water level (ca. 203 m above sea level) which was winnowed to sand and gravel, creates an exceptionally large catchment area for perched ground water. This has produced a diverse wetland system on the lower flanks of the gently sloping hillside, including springs, seepage surfaces, seasonal wetlands, lakes, a variety of different mires and streams. The waters of Lauhanvuori are home to wild brown trout *(Salmo trutta)*.

The summit of Lauhanvuori is covered by till formed during the Weichselian glaciation. The soil is rich in fine particles and nutrients and the summit area hosts a lusher vegetation than the slopes. The summit area has been known as a good place to cultivate potatoes in the past due to the absence of summer frost.

Geodiversity and its connection to both biological and cultural diversity in Lauhanvuori is easily explored at geosites along the trail network of the National Park. The area is managed by Metsähallitus, Parks and Wildlife, an important partner of Lauhanvuori - Hämeenkangas UNESCO Global Geopark.

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Wetlands are an important element of both geodiversity and biodiversity in Lauhanvuori.

(Photo by Tea Karvinen / Lauhanvuori - Hämeenkangas UNESCO Global Geopark).

Lesvos Island UGGp, Greece - Europe

Geodiversity in Lesvos Island Geopark

The largest known standing petrified trunk of a sequoia tree.

The long geological history of Lesvos Island UNESCO Global Geopark is reflected by its complex geological structure and the large number of geosites, such as volcanoes, hot springs, important fossiliferous sites, faults, waterfalls and coastal landforms, which are significant evidence of the geological history of the Aegean area over the last 300 million years.

Western Lesvos is dominated by the Petrified Forest, characterized as a 'Protected Natural Monument'. It is one of the finest and rarest geosites in the world. Remains of fossil plants, declared as a Protected Natural Monument, have been found in many localities on the western part of Lesvos Island. The fossilized plants in Lesvos are the silicified remains of a sub-tropical forest that existed on the north-west part of the island 20 million years ago.

The remains of an impressive petrified tree trunk found under water.

The preservation of the Petrified Forest is closely linked with volcanic activity in the Northern Aegean region during the Lower Miocene approximately 20 million years ago. At this time the forest was buried during a volcanic eruption by ash and lava. The large number of standing petrified trunks in growth position with their root systems intact is characteristic of an autochthonous petrified forest.

Systematic excavations in the parks of the Petrified Forest have revealed unique fossils which form archives of the Earth's history and the evolution of the life of the past. They are also indicators of the climatic conditions, the palaeo-environment and the palaeo-geography of the Aegean.

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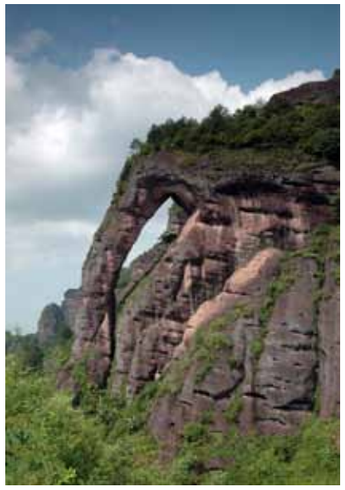
An impressive petrified root system in the area of the Petrified Forest.

Longhushan UGGp, China - Asia

Geography and Geodiversity of Longhushan Geopark



Danxia natural bridge, Elephant Trunk Hill. Erosion by water and solution along groups of joints in a stone girder resulted in small vertical caves. Continuous erosion and solution with the enlargement of the caves combined to produce the Danxia natural bridge in the shape of an elephant's trunk.

The Longhushan UGGp(UNESCO Global Geopark), covering an area of 996.63 km^2, is situated on the northern piedmont of the Wuyi Mountain Range in the northeast of Jiangxi Province, southeast China. It boasts spectacular Danxia landforms, eye-catching peaks and unusually-shaped rocks, such as the Fairy Maiden Rock, Elephant Trunk Hill, and Turtle Rock. The geoheritages of the Geopark feature Danxia landforms, as well as volcanic landforms, sedimentary structures and type sections. The Longhushan UGGp is the birthplace of Chinese Taoism which has had a profound influence on Chinese culture and even on current Chinese society. The Longhushan UGGp is famous for Danxia landforms, the Cradle of Taoism and the cliff burial culture of the Spring-Autumn Period.

The Geopark is located on the Beihai-Shaoxing Paleo-suture where the Yangtze and Cathaysia Plates collided. This suture controlled the red Xinjiang Faulted Basin which is oriented primarily in an east-west direction. The Danxia landform is the main landscape resource in the Geopark, with an area of 4/5 of the total area of the Geopark. There are a complete series of Danxia landforms ranging from juvenile through mature to mature stages in the Geopark. These consist of Danxia peak clusters with flat tops and steep faces, hoodoos and mesas with round tops, and coexisting Danxia peak clusters, hoodoos, isolated peaks and kopjes, respectively. Mature stage Danxia landforms predominate in the Geopark, especially those in the late mature stage which are typical. It reflects the full information of the Danxia landform's evolution. Tectonic erosion is the main reason for their formation; other processes such as current scour and erosion, corrosion, collapse, illuviation, and corrosive weathering and collapse also play a part. There are 23 types of landform including stone castles, red walls and cliffs, hoodoos, Danxia peak clusters, stone girders, stone walls, hoodoo columns and caves.

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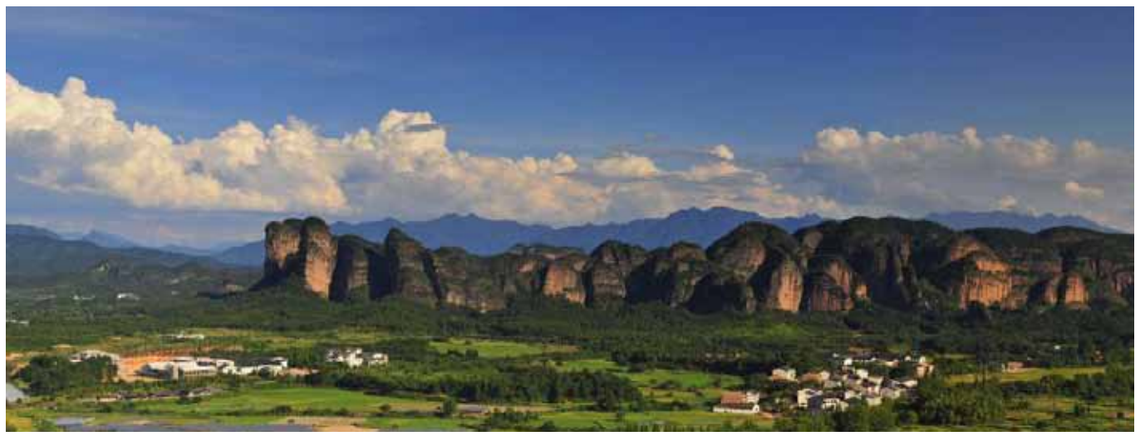
Danxia Peak Cluster, PaiYa Stone. A long period of erosion and solution along joints in the originally relatively complete and flat mountain surface produced stone peaks, stone walls and stone pillars with various heights, shapes and sizes, which together made up the peak clusters.



Lushan UGGp, China - Asia

Geodiversity of Lushan Geopark

Hanpokou U shaped Valley.

Lushan UGGp, located in the northern part of Jiangxi Province, China, borders the third longest river in the world, the Yangtze River, and Poyang Lake the largest fresh water lake in China. In 2004, the Geopark became one of the first members of Global Geopark Network.

Mt. Lushan is well-known for its unique and complex multi-genetic landforms created by Quaternary glacial erosion and landforms typical for eastern China that were produced by fluvial erosion and deposition. The landforms of this block mountain are closely integrated with botany, culture and history.

Lushan UGGp has areas of fantastic natural beauty, including dense forests, running streams, waterfalls, gorges, ridges and peaks. Villas of Chinese and western architectural styles are scattered among the mountains, where five religious cultures coexist in harmony. Its strong historical inheritance and the deep Chinese and western cultural roots make Mt. Lushan a culturally sacred mountain.

Tourists will notice that most of the mountain's rocks are composed of Neoproterozoic sandstone, the Liantuo Formation, which formed about 800 million years ago when the Lushan area was occupied by a shallow sea. Over millions of years the sediment and sand from the sea combined and hardened forming the sandstone of present-day Lushan.

Mt.Lushan experienced two tectonic - metamorphic -magmatic events associated with granite intrusions in Neoproterozoic rocks. The first event dated at approximately 127 million years ago was associated with fold deformation (the Lu anticline) in response to the syntectonic intrusion of granite. The second event involved the contemporaneous development of an eastern ductile shear zone and granite intrusion at approximately 100 – 110 million years ago (Han et al, 2021)

The Lushan block mountain, formerly interpreted as horst fault block mountain bounded by normal faults, is reinterpreted in the recent investigation by Han et al (2021) as an extrusion structure bounded by a low angle normal fault in the west (Lianhuadong fault) and a reverse fault in the east (Xingzi fault) both dip in a WNW direction. Mt. Lushan is situated on the upthrown footwall sides of the boundary faults which define a wedge-shaped structure with a normal fault at the top and a thrust fault at the base.

The estimated 13 - 33 million years required to erode the hanging wall of the Xingzi fault to its present level suggest that Mt. Lushan was uplifted during the Miocene Epoch. The uplift is attributed to the generation of the vertical extrusion structure in a tectonic compressional regime in response to Pacific plate movement.

About 3 million years ago, during the Quaternary Glaciations Period, thick ice covered the high peaks of Lushan. This ice moved downwards shaping different landforms on its way: U valleys, hanging valleys, cirques, and horn peaks. The present-day Ruqin and Lulin Lakes were firn basins.

There are many interesting phenomena in Lushan connected with its geological history. For example, the mountain's delicious potatoes and fragrant Cloud and Fog Tea are products of the geochemical characteristics of its soils. The sweet water mountain springs together with many Chinese medicinal herbs are products of Lushan's unique geology.

Over the course of millennia the sea has been transformed into a beautiful mountain. The long and rich geological history has brought us extraordinary plants and landscapes. Lushan is truly a living geological textbook!

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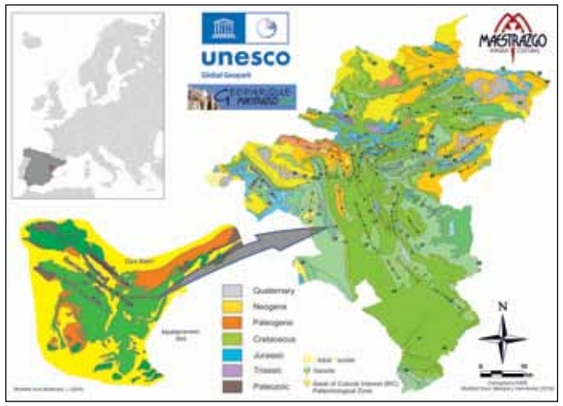
Reference: *Han, Zhiyong, Pan, Rouxian,Li, Xusheng,Liu, Yujia,Li, Yufang and Wang, Xianyan, 1921. Burial ages imply Miocene uplift of Lu Mountain in East China due to crustal shortening. Frontiers in Earth Science, Volume 9, id.127 (March 2021), DOI: 10.3389/feart.2021.634105*

A view of the Five Old Men Peak.

Ruqin Lake in Autumn.

Maestrazgo UGGp, Spain - Europe

Singular Geological Elements of the Maestrazgo Geopark



Geological map with Geosites of the Maestrazgo UGGp (Spain) in the eastern part of the NW-SE Iberian Mountain Range that link up with the Catalanides at their eastern and southern extremes, through the Maestrazgo area.

The Pitarque River Natural Monument works as an enormous underground reservoir where the main spring flow rate can reach up to 1,500 litres per second. It´is one of the four Natural Monuments according with the Natural Network of Aragon (Government of Aragon).

(Photo by Nebulosa Gráfica & Parque Cultural Maestrazgo).

Within the Aragonese western branch of the Iberian Mountain Range, formed during the Alpine Orogeny, the geological heritage of the Maestrazgo UNESCO Global Geopark (UGGp) is composed of a great variety of remarkable geological elements. It is essential that the variety of landscapes, rocks, minerals, fossils and geological formations within the Geopark are preserved as part of the natural wealth of our planet Earth.

The destruction of the heritage is irreversible and represents the loss of a part of the Earth's memory. Therefore the research, conservation and dissemination of this heritage is the responsibility of the Maestrazgo Geopark and has been promoted for some time. With more than two decades as a Geopark, its origin dates back to 2000, when four European territories including Maestrazgo agreed to create the European Geoparks Network (EGN) as a system to promote regional development by using unique geological resources through responsible geotourism. Moreover, this UGGp includes within its boundaries the Aliaga Geological Park, the first to be established in Spain in 1993.

The current inventory of the Geopark, with 71 Geosites, which includes 37 sites inventoried by the Government of Aragon Catalogue (Decree 274/2015). Four sites (Órganos de Montoro, Crystal Caves, Pitarque River valley and spring, and La Fonseca Natural Bridge) are declared as Natural Monuments (Natural Network of Aragon, Government of Aragon).

The Geodiversity Day 2022 poster for the Maestrazgo UGGp contains 71 Geosites of interest for different disciplines of geology, such as palaeontology, stratigraphy, tectonics, geomorphology, petrology or mineralogy among others.

We are referring to a Geopark with a huge geodiversity that includes two Geosites of International Relevance according to the Global Geosites Programme of the Geological Survey of Spain (IGME). These include the Jurassic-Cretaceous dinosaur sites in Galve (FC006) and the Mesozoic series of Gúdar Range in the Maestrazgo Area (MZ0049) which includes seven stratotype sections.

The presence of 16 new genera and more than 100 new fossil species discovered and described within the Maestrazgo UGGp territory deserves special mention. These include the first new dinosaur, *Aragosaurus ischiaticus,* described from Galve and *Trachyaspis turbulensis,* the first Mesozoic turtle described from Gargallo. The long list of palaeontological sites associated with dinosaurs includes 76 catalogued palaeontological sites, six of which were protected as Assets of Cultural Interest (BIC).

As a supplement, this Geopark has a large number of Assets of Cultural Value including 10 historical Sites, 21 monuments and more than 600 archaeological sites. Six of the Rock-Art Sites are part of the UNESCO World Heritage Designation (Rock Art of the Mediterranean Basin on the Iberian Peninsula, 1998). Moreover, there are two items included within the UNESCO Intangible Cultural Heritage List in the Geopark. These are the Art of drystone walling, knowledge and techniques and the Tamboradas drum-playing rituals.

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Massif des Bauges UGGp, France - Europe

Geodiversity, the link that unites us

Aerial view of Arclusaz syncline, in Urgonian Limestone.

Photo by Rectimo aviation

Geodiversity is a great way of getting the public interested in geo-heritage and what it tells us about our world. It helps us to appreciate the richness of landscapes and to understand the uses and scarcity of mineral resources.

Its revelation can thus help us to reconnect Man and Earth, as the motto of the geoparks enjoins us to do. It is a sensitive, aesthetic and emotional approach that can help us to bring the public to an understanding of the dynamics and resources that the Earth offers us.

For the Massif des Bauges UNESCO Global Geopark, the Geodiversity Day initiative is also an opportunity for better collaboration between UNESCO Global Geoparks and to be more effective in our joint or individual communications. It is a question of positioning our Geopark in its entirety: showing that we are a particular witness of a unique history; that our rocks, of the same age or type, are found in different territories and bear witness to one and the same history. Man has had similar uses for mineral resources throughout the ages. Today's ease of trade and globalisation have made us lose sight of this link with these resources, with the origin, the specificity and often the rarity of these resources.

The exploitation and transformation of iron plunges us into the human history of our territory. But to interest the public in the origin and location of the deposits plunges us into the geological and climatic history of the Earth.

Our Jurassic and Cretaceous limestones are part of our identity, but we share them with other geoparks where they are also a part of the landscapes of the Chablais UNESCO Global Geopark or the Causses du Quercy UGGp. We also have our ochre sands, as in the Luberon UNESCO Global Geopark. Our molasse rock sequence shares the same origin as that of the Haute Provence UNESCO Global Geopark.

Linking outcrops of the same age or of the same origin across the nation, Europe or the world can give meaning and connection to all the peregrinations of our fellow inhabitants on our territories. The creation of a support or a shared information base would allow each geopark to be more efficient and visible. It would enable the UNESCO Global Geopark to be a key player in the reconnection of the links between man and the Earth.

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The medieval village of Alby-sur-Chéran, built with Miocene molasses.

(Photo by Millimetrage).

The Trélod and dent de Pleuven, a prominent summit in the Massif des Bauges UGGp.

(Photo by Millimetrage).

Mëllerdall UGGp, Luxembourg - Europe

The Geodiversity of Mëllerdall Geopark

The up to 100 m thick unit of the Luxembourg Sandstone developed during the Lower Jurassic (Hettangian).

Photo by NGPM, U. Fielitz

Mëllerdall UNESCO Global Geopark is located in the east of the Grand Duchy of Luxembourg and on the NE rim of the Paris Basin. The region's sedimentary rocks were deposited from the Early Triassic to the Lower Jurassic in a depression between the London-Brabant Massif and the Rhenish Massif. An alternation of sandstones, marls, dolomites and limestones of in total about 500 m in thickness was deposited in continental and shallow marine environments.

The up to 100 m thick Lower Jurassic sand body of the Luxembourg Sandstone forms one of the most impressive sandstone landscapes in western Europe. It developed during the Hettangian and Sinemurian as a tidally-influenced offshore sandwave complex in a shallow-marine environment in the vicinity of the coastline of the Ardennes mainland. It is a quartz sandstone with calcareous cement, spatially limited and intercalated as a lenticular body in the Lorraine normal facies, which is in the wider area generally blueish grey, fine grained, marly and locally calcareous. As a result of the diagenetic redistribution of calcite and thus different content of the calcareous matrix within the unit, more cemented components are classified as calcareous sandstone and the less cemented parts as sandstone. An abundance of sedimentary structures can be seen on the rock faces. Spherical or ellipsoidal cavities formed due to the complete dissolution of more calcareous components or by honeycombed weathering. The formation of calcareous tufa by the recrystallization of dissolved calcite can be observed in several springs.

The Luxembourg Sandstone has long-term discharge and excellent filtering capacities and provides an essential reservoir for drinking water, enabling the region to be nearly self-sufficient in this respect. Smaller groundwater reservoirs above marly interlayers within the Luxembourg Sandstone unit, in dolomitic and calcareous beds inside the marly units or in other sandstones yield a broad spectrum of different ground waters with complex interactions in the region.

The alternation and inclination of the rock units was a basic prerequisite for the formation of the region's small-scaled cuesta landscape, which developed since Neogene times. The Mesozoic strata were epigenetically dissected by rivers and creeks, exposing high cliffs in the Luxembourg Sandstone and in dolomites on the valley slopes. A large number of geomorphological forms (mainly fluvial and gravitational) relate this geomorphological story and describe the vividness of the geological processes which were active especially during the Pleistocene.

Due to their sediment and pollen content, small and often water-filled depressions in marly strata ("mardels") are very interesting for palaeoecological and palaeoclimatic studies. Their development is explained by the dissolution of gypsum or limestone lenses or beds embedded in the marly strata, and by the subsequent lowering of the surface.

Groundwater rich in iron and salt emerges from the red sandstone rocks of the Lower Triassic Buntsandstein group.

Photo by NGPM, B. Kausch

A Mardel developed in and gypsiferous marls of the Middle Trassic Keuper group, a trap for quaternary pollen and sediment.

Photo by NGPM, B. Kausch

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Mudeungsan UGGp, Republic of Korea - Asia

The Harmony between Volcanic Activity and Sedimentation in Mudeungsan Geopark

The Mudeungsan Geopark, located in the southwestern Korean Peninsula, shows a wide range of geological periods from the Precambrian Period to the Cenozoic Era, and includes various geosites such as colonnades, a dinosaur fossil site, periglacial sites, and mixed geology-culture sites. The major geosites of the Geopark, Mudeungsan Mountain, which formed during late Cretaceous (87-85 million years ago) are well-known for the globally rare, large-scale colonnade structures with widths of up to ~ 7 metres. Most of the columnar jointed collonades are broadly distributed in the upper region of the Mudeungsan Mountain (> 750 metres above sea level) and are composed of dacitic tuff (defined as Cretaceous 'Mudeungsan Tuff'; Lim et al, 2015). In addition to the volcanic structures, the Seoyu-ri Dinosaur Fossil Site has the most extensive and diverse theropod trackways in South Korea. One unique trackway shows that theropods increased their stride lengths to achieve maximum speed when running Bo Seong K. and Huh M. 2010). Recently, fossil footprints proving that pterosaurs lived in groups were also discovered here for the first time in the world (Jung et al, 2022). A series of prone and leaning statues of Buddha in Unjusa (Temple) show weathered structures of the well-stratified pyroclasts, reflecting ordinary people's religion during the Late Chosun Dynasty (14th century). In addition, the Hwasun Dolmen Site, designated as a World Heritage Site by UNESCO in 2000, has 596 Dolmens made from welded tuff. This site is useful to reveal the prehistoric burial cultures in the southern Korean Peninsula.

In addition, interesting geosites were newly discovered during the process of continuous research to identify the geological value of the Mudeungsan Geopark. One of these is a site, in the middle of Chuwolsan Mountain located in Damyang County, with rocks with orbicular structures. Both the orbicular structures and the intervening matrix consist of rhyolite with the same composition. However, the formation process has not yet been clearly identified. Since this is a globally unidentified rock type, it is expected that, with continued research, this will become another world-famous attraction. The Damyang Wetland is another new geosite. This inland wetland is characterized by well-preserved ecological features. However, geological studies revealed that the shape of the river changed due to changes in water level in response to past climate change. As a result of the sediment study, pollen was also found, so it was possible to know the types of plants that lived during various periods of time.

The geodiversity in the Mudeungsan Geopark creates a very interesting territory which is in harmony with nature, history, and culture. Through this, we want to use it as a new opportunity for the development of the Mudeungsan area, which has been relatively slow in development.

Gwangseokdae Colonnade in Mudeungsan Mountain.

Seoyu-ri Dinosaur Fossil Footprint site.

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Ningde UGGp, China - Asia

Characteristics of typical geological heritage in Ningde Geopark

Taimushan miarolite peak cluster stone egg landform. Taimushan Scenic Area is composed of rock peaks, rock forts, rock walls and rock pillars. These striking landscapes together with various shaped stone eggs create a beautiful scenic landscape. In addition, the lane valleys, fissure valleys, canyons and cave and potholed landscapes are also very special.

Ningde UNESCO Global Geopark is situated in Ningde City, northwest of Fujian Province, China. The Geopark covers an area of 2,660 km^2, including four core areas of Taimushan, Baishuiyang, Baiyunshan, and Jiulongji. The Geopark is characterized by late Mesozoic granite and volcanic mountain landforms, modern river erosional landforms, as well as coastal and island landforms. In addition, the territory has an abundance of landscapes created by humans and wonderful ecosystems. It is therefore a large comprehensive Geopark.

The tectonic movements that occurred during the late Jurassic and early Cretaceous (150 to 100 million years ago) triggered mass magmatic intrusions and volcanic eruptions in eastern China. These resulted in the formation of the famous Zhejiang-Fujian-Guangdong igneous-rock zone. The Geopark is located in the centre of the zone and therefore is one of the most typical and intense areas of the magmatic events. The park has typical volcanic strata, volcanic rocks, ancient volcanic structures, columnar jointed volcanic and intrusive igneous rocks, and a variety of very special intrusive rock consisting of alkali feldspar miarolitic granite. These events clearly show the formation, development, and evolution of the Mesozoic continental marginal active zone in southeastern China.

The miarolitic granite-dominated Taimu Mountain is characterized by thousands of fantastic peaks, rocks and caves. The towering peaks are rugged and steep; stone eggs are are similar in shape to human beings or to other objects; corridor-or fault-style caves originating from rock fall and accumulation are secluded, tranquil and intersect one another. The flow-erosion-induced vertical rock fissures on the cliff walls are magnificent.

The riverbed of the Baishuiyang River is wide and flat with a length of 2 km. It is composed of bedrocks. The river is divided into upper, middle and lower parts. The middle part which is is 182 metres in width forms a vast shallow water square with an area of near 40,000 m^2 and is a wonderful place to enjoy the river and the water.

Flow erosion-generated caves and potholes are well developed in granites in the river valleys of the Baiyun Mountain area. In the 5,000 metres long river valley of the Chanxi Canyon, there are dense concentrations of caves and potholes. Some are house size others are as small as a cup. They range in shape from mortar, basin, urn and niche and can also occur as potholes caves and troughs. This rare and wonderful concentration of potholes and caves is a masterpiece created by water-flow erosion.

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Chanxi Canyon potholes. In the 5,000m-long river valley of the Chanxi Canyon, the countless densely-distributed potholes and caves are the masterpiece created by scour on the bed of a fast flowing river.

The Baishuiyang flat-bottomed riverbed. Covered by vast shiny, sparkling and clear water, having an extensively wide and flat riverbed, this is the rarely-seen Shallow Water Square of the Baishuiyang flat-bottomed riverbed.

Non nuoc Cao Bang UGGp, Viet Nam - Asia

Geodiversity in Non Nuoc Cao Bang Geopark

Ban Gioc waterfall

Phong Nam karst landscape

Non nuoc Cao Bang Geopark is located in the north of Vietnam and covers a total area of 3,683 km^2. The Geopark is characterized by its complex geology and diverse mineral resources. In the Geopark, evidence for the geological periods Cambrian, Devonian, Carboniferous, Permian, Triassic, Cretaceous, Neogene and Quaternary were discovered.

Approximately 2,000 km^2 of the Geopark is a limestone area that was an ancient ocean hundreds of millions years ago. Different karst landforms represent a full cycle of karst evolution from the beginning to the senescent phase. Karst landscapes representing the mature and senescent phases including karst ranges, peak-cluster depressions, karst cones, tower karst, karst fields, etc. Other areas of Non nuoc Cao Bang Geopark, including terrigenous sedimentary rocks and magmatic intrusive-volcanic rocks, are also equally diverse and outstanding. They represent a long and complex geological history with numerous sedimentary disruptions, extinction events, the preservation of endemic palaeo-species, and magmatic-intrusive events associated with hydrothermal mineralization.

Different fossils were also found in the Geopark such as ancient corals in Nguyen Binh district, ammonites in Luong Luong, Ha Quang district, brachiopods in Minh Long, Ha Lang district, etc. These fossils are evidence of a long-lasting geological process in the area of an ancient ocean that experienced periods of uplift. They are fossils of marine organisms living in a shallow sea under a hot climate therefore these fossils are valuable indicators of the geographical-geological conditions relating to an area of the Earth's crust.

Another feature that plays an important role in the geological evolution in Non nuoc Cao Bang UGGp is the evidence for fault activity in Cao Bang -Tien Yen deep fault. This fault is auxiliary to the well-known deep Red River fault zone, which is a manifestation of the collision between the Indian Plate and Eurasian Plate in South China and North Vietnam. Along this fault in Northeast Vietnam, including Cao Bang, the separation in the Earth crusts, 260-230 million years ago formed new oceans, together with orogenic and mineralization processes. The lateral movement along the Cao Bang – Tien Yen fault 56-5.33 million years ago triggered the appearance of a series of major lakes with alluvial fans, river mouths and swamps. The faulting also resulted in the formation of spectacular karst caves and waterfalls, such as Thang Hen lake system with turlough phenomenon, Nguom Ngao cave, Doi cave, and Ban Gioc waterfall, etc.

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Mountain Angel Eye

Salpausselkä UGGp, Finland - Europe

A Landscape Created by Water in Salpausselkä Geopark

Pulkkilanharju Esker cutting across Lake Päijänne in Salpausselkä Geopark, Finland.

(Photo by Johannes Sipponen / Salpausselkä Geopark).

The main geological features of international value in the Salpausselkä UNESCO Global Geopark are the outstanding glaciofluvial landforms, which rest on a nearly 2 billion years old bedrock.

The Salpausselkä ice-marginal ridges represent the best-known geological heritage of Finland and hold a record of the prehistoric climate change during the Younger Dryas period, which occurred around 12,800 – 11,600 years ago, at the end of the last Ice Age. The natural historical importance of the Salpausselkä ridges is immense, as they are exceptionally well developed and reveal the continuous ice-marginal positions of the Younger Dryas period, a system of ice-contact deltas and other ice-marginal deposits. Together with the long, distinct feeding esker chains the Salpausselkä ridges form a unique example of glaciofluvial landforms within the Geopark area. These landforms consist mainly of sand and gravel transported, sorted and deposited by glacial meltwater streams during the melting phase of the Ice Age. They are central features in the landscape of the area, along with the plentiful lakes. Lakes developed mainly in the bedrock's fracture zones, which were eroded and deepened by the ice sheet and its meltwaters. The ancient bedrock can be seen in many places as impressive outcrops.

This scenic 'landscape created by water' tells a story of the power of water in shaping our environment, both in its liquid and solid phase. The Salpausselkä Geopark highlights that the landscape is also a significant source of water. The massive glaciofluvial landforms of the area are vitally important for their abundant, renewable reserves of groundwater, which can be enjoyed as naturally high-quality drinking water. All of the tap water in the area comes from groundwater which is also an important natural resource for the region's strong food and beverage industry. Furthermore, the southern part of Finland's second largest lake Päijänne, which is situated in the Geopark, is the main water source for over a million people in the capital area. Protecting the valuable water resources is a major theme in the Geopark.

The hundreds of lakes within the Geopark area, along with the forest-covered ridges and hills, offer stunningly beautiful views and ideal surroundings for recreation, exploring nature, outdoor activities and geotourism. The key geological features and elements of the landscape, the ancient bedrock, the glaciofluvial landforms, the bodies of water, can all be seen and experienced at easily accessible sites. The distances from one attraction to another are short, and several geosites are situated along well-maintained marked trails. Waterways connect the whole area, providing excellent opportunities for paddling and boating. Many of the geosites are located within or close to the city and municipal centres and are accompanied by aspects and sites of rich natural and cultural heritage.

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Nordic Ski World Championships in Lahti Sports Centre at Salpausselkä ice-marginal ridge in Salpausselkä Geopark, Finland.

(Photo by Lassi Häkkinen / City of Lahti).

Pirunkirkko rapakivi cliff in Paistjärvi Nature Reserve in Salpausselkä Geopark, Finland.

(Photo by Kati Komulainen / Salpausselkä Geopark).

Sanqingshan UGGp, China - Asia

The diversity of Granite landforms in Sanqingshan Geopark

Oriental Goddess Peak

(Photo by Zhang Zhengtao)

A view of the Yujing Peak landscape.

Sanqingshan UNESCO Global Geopark is recognized as a great example in Earth science. It records an Earth history spanning over 800 million years, including excellent examples of stratigraphical, petrological, tectonic, and geomorphological significance. The Geopark has rare biotic communities that evolved over more than 200 million years. There are varied, typical and centralized granite micro-landforms.

The Geopark is a mountainous area with a large granite base at its the centre. The micro-landforms in the granite body are extensively developed, with 11 diverse forms, i.e., peak, peak wall, peak cluster, pinnacle, stone forest, peak pillar, stone cone, cliff, canyon, odd-shaped stone, caves and more. The micro-landforms of outstanding scientific value, are rarely seen in the granite landscape, and provide typical examples for studying granite micro-landforms and their evolutionary process.

A python slithers out of the Mountain.

(Photo by Lian Shili).

As the unique peak forest is formed by "Sanqingshan-style granite" which forms landforms easily and differs from other granite landforms in the world, it is named as the "Sanqingshan-style peak forest".

The differences between the Sanqingshan-style peak forest and others are as follows:

- High granite peaks or columns with spires on the top are densely distributed in a relatively small area, forming a unique granite peak forest.
- There are a range of small stone cones and clints on the tops of granite peaks or columns.
- The area contains a variety of micro-landforms with remarkable odd-shape rocks.
- Granite landforms are combined with unique varieties of vegetation, clouds and mists creating a natural wonder.
- Granite landforms show vertical and regional zoning controlled by shape, location and tectonics.

It shows that "Sanqingshan-style peak forest" is controlled by the shape, and location of a rock mass, cut by shallow structures and eroded by runoff. As a result, Sanqingshan Geopark is called a natural museum and textbook of granite geology and geomorphology.

Due to the "Sanqingshan-style peak forest", the Geopark comprises an outstanding assemblage of landforms of varying scales. The area is important because its geomorphic features are abundant, diverse and of high quality. Particularly special is the high concentration of granite micro-landforms, many of which are remarkably sculptured by natural processes. The landforms are of nine different types, known as overlapping peaks, peak walls, peak clusters, stone forests, peak pillars, cliffs, gorges and odd-shape rocks. The central park of 2,800 hectares includes 48 individual peaks, 89 odd-shape rocks, and 361 individual landforms of note.

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Seridó UGGp, Brazil - S. America

The Seridó UGGp Geodiversity that frames the Brazilian ‘sertão

Gallery explored for extraction of scheelite in the Mina Brejuí Geosite, municipality of Currais Novos.

(Photo by Silas Costa).

Twentyfive million year old basaltic columnar jointing in the Vale Vulcânico Geosite, Cerro Corá municipality.

(Photo by Marcos Nascimento)

Translating the Brazilian ‘sertão’ is something difficult to make understood for those who do not know it. The ‘sertão’ is an entity, it is a way of life, it is a social construction, but also an environmental one. Very marked by the drought, but also by the richness of its culture and landscapes.

The Seridó UNESCO Global Geopark is located in the ‘sertão’ of Northeast Brazil, a territory of more than 2,800 km² with a population of over 120,000 inhabitants. Integrated within the International Geosciences and Geoparks Programme and the UNESCO Global Geoparks Network since 2022, it is a region with a geodiversity, and geological heritage, of scientific, educational, touristic and cultural importance. There are six municipalities: Acari, Carnaúba dos Dantas, Cerro Corá, Currais Novos, Lagoa Nova, and Parelhas.

The geodiversity is the result of an evolutionary process of over 2.2 billion years. The intrusion of plutonic rocks which were later subjected to metamorphism gave rise to the regional basement of the territory. The overlying Neoproterozoic metasupracrustal rocks, together with plutonic rocks that include a series of orogenic cyles within the so-called Brasiliano cycle, make up more than 70% of the territory. These rocks are associated with the break up of Gondwana during the Mesozoic Era,.

Hydrothermal processes associated with granitic intrusions generated important scheelite (CaWO4) mineralization. The mineralization event located at the Mina Brejuí Geosite is one of the largest in South America. The exploration of this ore promoted, even in the 1940s, the strong economic development in the region. Currently, mining activity continues, but the creation of a theme park and the inclusion of the geosite in the Seridó UGGp show that tourist and educational activities can also generate income.

The geodiversity of Seridó UGGp also contains a record of one of the most recent examples of volcanic activity on the South American Platform. In the Vale Vulcânico Geosite, the main highlight is the occurrence of disjointed units columnar basalt with different angles of dip, ranging from horizontal to inclined, together with peridotite nodules. The volcanism that generated these structures is dated to 25 million years.

Mountains, hills, plains, depressions and valleys are some of the features represented in the the landscape, and are all elements of the geodiversity They are the products of the Earth’s natural processes and tell the story of millions of years of evolution.

In addition to being an important component of nature, the geodiversity of the Seridó UGGp territory is a source of inspiration for its population, and its artists. It provides data for researchers from different disciplines and brings the community closer to its surroundings. It is not by chance that this ‘sertão’ community visits geosites and learns from nature the importance of its abiotic elements. This territory, therefore, has a unique geodiversity, to be celebrated and known by all visitors, researchers and interested parties.

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Training activity for teachers at Cachoeira dos Fundões Geosite, municipality of Carnaúba dos Dantas.

Photo: Silas Costa.

Sobrarbe-Pirineos UGGp, Spain - Europe

Geodiversity in a mountain environment in the Sobrarbe-Pirineos Geopark

Large Variscan folds in the Lardana Massif.

Boltaña anticline, one of the main tectonic structures in the central Pyrenees has an unusual orientation.

In the heart of the Spanish Pyrenees, Sobrarbe-Pirineos UNESCO Global Geopark is the wildest part of the mountain chain.

While the northern area contains several high peaks, dozens of them over 3000 m above sea level., the south is composed of mild Mediterranean sierras. If there is anything characteristic about our Geopark it is its geodiversity.

From the Cambrian to Holocene, 550 million years gaze at us from our mountains. Many different types of rocks are present in the territory, exceptional sedimentary rocks include limestones and turbidites. The oldest rocks are mainly metamorphic and igneous in origin, created during the Palaeozoic at sites far removed from their present geographic position. But even now, inside the caves and in springs, new rocks such as speleothems and tufas are forming.

The Pyrenees are not the only footprint of plate tectonics in the area. The remnants of thrusts can be seen in the highest mountains, such as the Lardana Massif (3375 m). The whole territory was heavily deformed and uplifted during the Pyrenean orogeny, when Sobrarbe emerged from the former Pyrenean Sea. From the deepest sea floors to the continental fluvial deposits, the whole sedimentary record involves the emersion of the Sobrarbe-Pirineos. In addition a diverse set of tectonic structures reveals the evolution of the mountain chain, sometimes with unexpected folds like the large north-south anticlines, perpendicular to the main Pyrenean structures.

Due to intense erosion we can enjoy incredible rock exposures revealing the architecture of these mountains, together with a wide variety of landforms.

The highest areas are the kingdom of glacial features. Here the stories about the enormous glaciers that shaped the landscape during the Quaternary are revealed. Now, only two glaciers still survive in Sobrarbe’s mountains. The still active periglacial and karstic processes are represented in different ways by rock glaciers, ice caves, and especially in three more than one kilometre deep endokarstic systems. The fluvial network expresses the relief of the whole Geopark. Large rivers, like the Cinca and Ara, with beautiful braided sections, are the main arteries. In addition, a myriad of small tributaries form hidden gems inside the mountains.
An awesome geodiversity to enjoy and protect!

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Our largest glacier, Monte Perdido, is experiencing climate change in our mountains.

Swabian Alb UGGp, Germany - Europe

From Jurassic sediments to Karst phenomena, from volcanism to meteor impacts – the Geodiversity of the Swabian Alb Geopark

A limestone block that slipped into the volcanic vent at the outcrop of Aichelberg.

(Photo by Sandra Teuber).

Karst spring Ursprungtopf.

(Photo by Iris Bohnacker).

The Swabian Alb has an exciting Earth History, which produced the high geodiversity of the area and which can be experienced within the UNESCO Global Geopark.

During the Jurassic, 201 to 145 Million years ago, the area was covered by a tropical sea, where sediments were deposited. The resulting sedimentary rocks are the foundation of today's landscape and offer insights into our planet's past. In Holzmaden, famous for the Posidonia slate, Ichthyosaurs and other marine lifeforms tell the story of the Lower Jurassic period, which can be admired in a local museum but also in museums around the world, e. g. in the Natural History Museum in Stockholm. At Nusplingen, the world-famous fossils of the so-called Angel-sharks, of ammonites and of a giant dragonfly tell the story of an Upper Jurassic lagoon. Similarly, the corals in the Riffmuseum in Gerstetten let you explore the Upper Jurassic underwater world.

In the Tertiary period, volcanic activity in the area of today's communities Urach and Kirchheim u. Teck led to the volcanic phenomena visible in the landscape. The Randecker Maar an important remain of a maar created by water-vapour explosions arising from the contact between magma and groundwater. Today, it is a nature reserve where the local wildlife can be observed. More common, however, are the remains of volcanic vents. Some of them are visible to hikers. At the outcrop in Aichelberg, a limestone block that slipped into a volcanic vent was preserved and can be admired today.

Another rather spectacular event happened in the Tertiary period – the meteor impacts at today's Nördlinger Ries and Steinheimer Becken. It created two craters, the smaller one is located within the Swabian Alb UNESCO Global Geopark, the larger crater was designated as Ries UNESCO Global Geopark in 2022. In the Steinheim Basin, the central mound illustrates the dynamics of an impact event. Later, a lake formed within the crater. The fossil snails that originally lived in the Steinheim lake provide insights into evolutionary processes. It was here that Hilgendorf found evidence for Darwin's theory of evolution.

Visitors can further experience the karst landscape of the Swabian Alb. The limestone, originally deposited in the Jurassic sea, is subjected to karst processes so that a wide variety of geosites attract visitors. In twelve show caves, visitors can marvel about the size of these cavities and their richness in dripstones. At karst springs, people gaze in awe at the striking blue colour of the water. While a simple physical phenomenon – light scatters from the small particles dissolved in the water with the blue components dominating – the bright blue colour still magically attracts visitors. Dolines and dry valleys also illustrate how water contributes to the geodiversity of the UNESCO Global Geopark.

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Taishan UGGp, China - Asia

Geodiversity in Taishan Geopark

Rock cylinder with a barrel-shaped structure.

A fan shaped cliff.

Taishan UNESCO Global Geopark is located in central-western Shandong Province, China. Taishan, covering an area of 418.36 km² was approved as a Global Geopark in 2006. During the past 2.8 billion years, Taishan has experienced a series of dynamic and violent geological processes. Tectonic movements during the past 30 million years have played a decisive role in shaping the natural landscapes of Taishan. It is a classic area with the longest history of Early Precambrian Geological Research and the richest geological phenomena in China. It is the standard area for the Archean Palaeoproterozoic geological evolution in North China.

Due to its unique geotectonic position and the influence of tectonic movement there are many typical and peculiar geological and geomorphic features in Taishan. The Geopark is of great national and even international geological significance, including the Precambrian geology, a standard Cambrian sequence, neotectonic movements and its geomorphology. It is a natural geoscience museum.

1. Stratigraphical relics

The exposed strata of Taishan mainly include the Neoarchaean metamorphic supracrustal rock, the Palaeozoic Cambrian in the Zhangxia Gushan area, and the Cenozoic in the Shannan basin.

2. Rock relics

The intrusive rocks of the Archaean Palaeoproterozoic in Taishan are widely distributed, accounting for more than 95% of the area. The lithology ranges from ultrabasic, basic to moderately acidic rocks, but consists mainly of moderately acidic granite and diorite. The scale of the intrusive rock masses varies. However, the rock mass is oriented mainly NW, which is mostly consistent with the direction of the regional tectonic alignment. The genetic mechanism for the formation of the intrusive rocks is complex, and the multi-stage processes of magmatic evolution are very obvious.

The Taishan Group complex rock sequence.

3. Tectonic relic

The geological structure of Taishan is very complex and involves the formation of folds and faults There are structures which formed during the Precambrian, Mesozoic and Cenozoic. Younger structures are superimposed on and transformed older tectonic structures producing an an extremely complex structural pattern. In the diabase porphyrite vein of Taishan, there are many horizontal rock cylinders of different sizes. In cross-section each cylinder is composed of many concentric rings and a core, which is called the "barrel structure". Globally this is a rare phenomenon.

4. Hydrogeological relics

The hydrogeological relics of Taishan are very diverse, involving rivers, lakes, ponds, waterfalls, springs and other features.

5. Geological and geomorphic relics

Under the influence of tectonic movement, erosion and features associated with downcutting are prominent creating an undulating terrain with large contrasts in elevation. These created the majestic mountain scenery of Taishan, with a variety of eroded landforms and a number of amazing natural landscapes.

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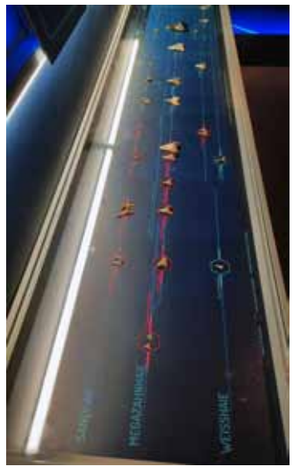
TERRA.vita UGGp, Germany - Europe

Coal swamp, dinosaur island, shark sea – the high diversity of palaeo-environments in the TERRA.vita Geopark

The sedimentary rocks at Piesberg contain many fossils, such as this extinct tree-like horsetail *Asterophyllites*. Photo by A. Leipner).

The Dinosaur Tracks of Bad Essen-Barkhausen are the first Upper Jurassic sauropod tracks described worldwide and the first Upper Jurassic theropod tracks found in Central Europe. (Photo by T. Fischer).



Explanation of the shark evolution in the HaiTec Centre of the Kuhlhoff Environmental Education Centre by exhibiting locally found shark teeth.

In the UNESCO Global Geopark TERRA.vita, the past 300 million years of Earth's history are almost continuously exposed in an area of just 1,550 km² in the Northwest of Germany. TERRA.vita is a sedimentological Geopark, that was shaped by tectonic and glaciogenic processes and is characterized by unique palaeontological features. In each epoch of the Geopark's geological history unique paleo-ecosystems existed, that have been preserved as rocks and fossils. This special geology can be experienced at numerous geosites, in guided tours, on hiking and cycling trails or in museums. These are TERRA.vita's main highlights for each geological epoch:

From the time of the Carboniferous coal swamps, not only the anthracitic coal, but also many plants and large arthropods have been preserved as fossils. The rocks can be viewed in the Piesberg Cultural and Environmental Park and the fossils are exhibited in the Museum for Industrial Culture and in the Museum am Schölerberg.

The oxygen-depleted conditions of the Permian "Kupferschiefer" lagoon facilitated the soft-tissue preservation in archosaur and fish fossils. The rocks can be viewed at the TERRA.track Geological Educational Trail at Hüggel. Fossils from Schafberg are displayed in the LWL Museum of Natural History in Münster.

Dry, almost arid conditions caused the Triassic limestone mudflats of the Mid-Triassic to evaporate regularly. Yet they were full of life. Numerous ichnofossils can be viewed in the rock faces of the Silbersee Visitor Gallery and in the Botanical Garden of Osnabrück University.

Herds of sauropods wading through shallow water along the beach, single theropods hunting, and marine reptiles swimming in the sea – the TERRA.vita area was an island ruled by dinosaurs in the Jurassic. The Dinosaur Track site Bad Essen-Barkhausen is an abandoned quarry, where visitors can view dinosaur footprints. A copy of the skull of the theropod Wiehenvenator, the "hunter from Wiehen Hills", is displayed at the TERRA.vita Information Pavillon in Bad Iburg.

The Pyrenees' collision triggered the uplift of mountains in the TERRA.vita area, a geothermal event, and the deposition of sand- and limestones in a tropical sea during the Cretaceous. The weathering of the sandstone produced the bizarre formations in the Dörenthe Cliffs. The limestones can be best viewed along the Dyckerhoff Nature and Geotrail in Lengerich. Ammonites as large as truck wheels and other fossils are displayed in the Heimathaus Borgholzhausen and in the Natural History Museum in Bielefeld.

Sharks ruled the primordial North Sea during the Palaeogene and Neogene. Their teeth can be admired in the HaiTec Centre of the Kuhlhoff at the Ankum Heights. This hill chain formed in the ice age due to the surge of a glacier. Mammoth and woolly rhinos inhabited the area during steppe conditions. The "age of humans" is reflected by the 5,000 year old megalithic tombs, countless burial mounds, the remains of the Varus Battle, the Plaggen soils, and the Westphalian Peace monument.

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Tianzhushan UGGp, China - Asia

Geodiversity in Tianzhushan Geopark

Hanchangchong Geosite, also called Shuanghe, exposures of abundant rock types. It is one of the classic eclogite outcrops in Dabieshan orogenic belt.

Tianzhu Peak, the highest peak in Tianzhushan, resembles a gigantic pillar propping up the heavens.

Tianzhushan UNESCO Global Geopark is located in Anqing City, Anhui Province, P.R. China. It is connected with Dabieshan in the northwest and borders on the Yangtze River in the southeast, with a total area of 413.14 km².

Tianzhushan Geopark is located in the eastern part of Dabieshan Orogenic Belt between the North China and Yangtze Paleo-Plates and the southern part of Tancheng-Lujiang Fault Zone. It is recognized internationally as an important example of an ultra- high pressure (UHP) metamorphic belt with the most abundant combination of UHP minerals and rocks in the world. The formation of the UHP belt records amazing geological processes involving the subduction of a Palaeozoic ocean and the progressive exposure of deeply buried rocks at higher crustal levels due to colliding continental plates. Within Tianzhushsan Geopark, abundant UHP metamorphic rocks have been discovered, including eclogite, jadeite quartzite, gneiss, marble, serpentinite and garnet peridotite, etc. The discovery of coesite-bearing eclogite was the third example in the world and the first example in Asia. The discovery of diamond-bearing eclogite was the second example from a metamorphic belt. The discovery of tourmaline-bearing eclogite in marble was the first case recorded in the world and the first example from the Dabieshan UHP metamorphic belt, the largest UHP metamorphic belt in the world.

Tianzhushan Geopark is world-famous for its most beautiful granite landforms in the Tancheng-Lujiang Fault Zone. There are abundant granite peak clusters and peak forests in the northern part of the Geopark. In particular, the cave landscape formed by landslides and a collapsed stack of granite has been named as a "Tianzhushan type" landscape with collapsed and stacked rocks, represented by a Mysterious Valley. There are more than 50 peaks above 1,000 metres in elevation, and the main peak Tianzhu Park is 1,489.8 metres above sea level.

In addition, 63 species of vertebrate fossils with Asian endemic characteristics have been discovered in more than 20 fossil sites within Tianzhushan Geopark, which gives Tianzhushan a unique position in research of the evolution of Palaeocene mammals. It is recognized as "one of the birthplaces of Asian mammals and a treasure trove of palaeontological vertebrate fossils". Sixtythree species of fossils include 13 species of reptiles, 2 species of birds, 47 species of mammals and one dinosaur egg species. The two most significant species are *Heomys orientalis* and *Mimotona wana*. They represent the ancestral species of rodents and lagomorphs (rabbits and hares), which originated in Asia and are represented in Tianzhushan UNESCO Global Geopark.

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Reconstructions of the classic Palaeocene vertebrate fossils in Tianzhushan UNESCO Global Geopark.

Troodos UGGp, Cyprus - Europe

A unique geodiversity from a unique mountain in Troodos Geopark

1. Map of the Troodos UNESCO Global Geopark.

The Troodos UNESCO Global Geopark (TUGGp) is located in the central forested mountainous area of Cyprus with an area of 1,147 km². Its boundary, roughly delineated by the extent of the Troodos Ophiolite Complex (TOC), includes the most significant geological, ecological, archaeological, historical and cultural elements of the Troodos Mountain Range. It is considered to be the largest biotope of Cyprus, which hosts a rich and remarkable endemic flora and fauna co-existing in rare and protected habitats created by the unique lithology, topography and climate.

The birth of Cyprus is directly related to the formation and uplift of the Troodos oceanic crust, which was the result of a series of complex geological processes due to plate tectonics. It formed approximately 92-82 million years ago in the depths of the Neotethys Ocean by seafloor spreading. Subsequently, it was rotated and uplifted creating a dome structure due to the collision between the African and Arabian Plates with the Eurasian Plate.

It is very impressive that despite the 90º anticlockwise rotation, the large uplift to its present position and the diapiric elevation of its ultramafic rocks the Troodos retained all of its individual geological units in stratigraphic order creating a unique outdoor natural geological laboratory where every section on the mountain reveals a piece of its great evolutionary history.

That is why, since the 1950's, the TOC has been studied and researched in great detail, and undoubtedly played a significant role in the development of the theory of sea-floor spreading and the formation of new oceanic crust as we know it today.

In the area of the Geopark, a large number of geological and mining heritage elements are located such as:

- the highest peak of the Troodos Mountain range, Mount Olympus, which consists of mantle rocks that were created several kilometres below sea level and now are exposed at an elevation of up to 1,952 m,
- the largest historic asbestos mine in Europe in serpentinite, chromite deposits with mining galleries in dunite (an olivine rich igneous plutonic rock)
- outcrops of plutonic rocks which in places were intruded by younger dykes indicating the existence of multiple magma chambers during the creation of the TOC,
- outcrops of extensive parallel dyke landscapes that comprise the most irrefutable evidence of ocean seafloor spreading,
- rotated and epidotised dykes, spectacular landscapes of pillow lavas and lava flows.
- outcrops of "Cyprus-type" massive sulphide deposits with ancient and recent mining galleries as well as umbers in the pillow lavas which were created by ascending metal-rich hydrothermal fluids in the form of black smokers,
- spreading centre graben valleys and a fossilized transform fault.

These unique geological elements constitute an important and diverse Geopark with a significant contribution to a better understanding of the evolution of the oceans and our planet in general, and has established Cyprus as a geological model for geoscientists around the world.

In the TUGGp Visitor Centre, located in the old renovated elementary school of the rehabilitated Asbestos Mine, visitors are informed about this unique geodiversity through a detailed tour of the museum. It includes informative panels, maquettes, touch screens, stereomicroscopes, functioning seismographs, educational interactive games, videos and animations, a documentary film, rock and mineral exhibits and replicas of an ancient copper ingot, a furnace and a mine gallery from the last century. Through the "Seismology Corner," the "Kids' Room" and the "Natural Heritage Room" students can learn about plate tectonics, faults, earthquakes, seismometers, seismology techniques, geology and how the Troodos ophiolite complex has been created and uplifted to its present position.

Seize the opportunity to visit the geosites of the TUGGp, which are ready to share with you the story and the secrets of their great journey for a unique one in a lifetime experience.

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2. Dunite body with banded chromite near the Troodos square (Geosite 6).
3. Scenic view of the sheeted dykes at "Teisia tis Madaris" (Geosite 12).
4. An important exposure of the Lower Pillow Lavas of the Troodos Ophiolite Complex is located in a gorge of the Maroullena River (Geosite 3).

Yuntaishan UGGp, China - Asia

Geological Characteristics of Yuntaishan Geopark

Dragon Ridge Great Wall

Yuntaishan UNESCO Global Geopark, China (hereafter referred to as Yuntaishan UGGp) is one of the first group of Global Geopark Network Members approved by UNESCO in 2004. It is located at the southern foot of Taihang Mountain, north of Jiaozuo City, with an area of 556 km². It is an all-inclusive Geopark which combines scientific and aesthetic values. The landscapes are defined mainly by the geology and geomorphology of the valley structure and partially by the natural ecosystem and cultural landscapes. Yuntaishan UGGp has five typical geotourism routes. These are the Yuntaishan Geotourism Route, the Qingtianhe Geotourism Route, the Shennongshan Geotourism Route, the Qinglongxia Geotourism Route and the Fenglinxia Geotourism Route. All the landscapes in these five geotourism routes include splendid views with beautiful water features and mountains that are typical for southern China.

Hongshixia Valley, was formed in an area subjected to a one-billion-year succession of orogenic movements and water erosion. From 2.6 million years, the zigzag shaped Hongshixia Valley was formed by river erosion along two groups of fractures in the red quartz sandstones. It is about 1.5 km long, several metres to dozens of metres wide and over 60 m deep. The rock, which owes its red colour to the oxidation of iron-bearing minerals, creates the fabulous valley with red cliffs and crystal clear water.

The Whale Bay is a unique landform created by a long period of river erosion in an area controlled by north-south extensional zones and subordinate east-west faults.

The Dragon Ridge Great Wall is a ridge between two gorges, with a length of 11.5 m, a height of 100-200m and width of several metres to tens of metres. It is composed of limestone, which was cut into blocks of different sizes along two sets of vertical joints. It's like a stone wall of piled up giant stones, a natural great wall.

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Hongshixia Vally

The Whale Bay

Zhangye UGGp, China - Asia

Rainbow Mountains on the Silk Road

Caiqiu (Colorful Hills): Rainbow Mountains of China

Zhangye Geopark is situated in Zhangye City, Gansu Province, China, covering an area of 1,289.71 km². Geographically, Zhangye Geopark is located on the boundary between the Qinghai-Tibet Plateau and the Inner Mongolian Plateau, the middle section of the north slope of Qilian Mountains, and the transitional zone from Qilian Mountains to Hexi Corridor. Zhangye Geopark also lies on the ancient Silk Road, a fortuitous geographic advantage which resulted in the integration of eastern and western cultures. Consequently, in addition to its rich geodiversity, Zhangye Geopark also has a special cultural heritage.

Caiqiu (Colourful Hills) is one of characteristics in Zhangye Geopark. Caiqiu is composed of Early Cretaceous mudstone and silty mudstone which was deposited in a lake during the Cretaceous Period. Due to different minerals in rocks, Caiqiu shows marvelously varied colors. Caiqiu is also well-known as the Rainbow Mountains of China.

Binggou Danxia is another distinct feature in Zhangye Geopark. The red conglomeratic strata are preserved in this area, with various Danxia landforms, featured by the round tops, prominent ridges, steep cliffs and gentle slopes. The different stages in the development of the Danxia landforms range from the initial lane valleys and narrow ravines in initial stages of development, via rock walls, peak clusters and forests in the mature stage, to the residual peaks and pillars of the terminal stage.

The Chinese Yugur Customs Corridor is located in the centre of the Geopark. The Corridor connects the geological history and Yugur ethnic minority culture. The landscape here marks the uplift of the Qinghai-Tibet Plateau during the the Cenozoic Era. The Corridor, located in the western part of China, is a natural ecological and cultural zone integrating a geoheritage of glaciers, snow-covered peaks, primary forest, natural grassland, lakes and wetlands, waterfalls and rivers, gorges and local minority customs.

Jiugequan (Nine Springs) was the first area in which plate tectonics was studied in China and is of international significance. Here, an ophiolite suite is associated with the existence of the early Palaeozoic Qilian Ocean, where a plate suture bears witness to the collision between the Huabei and Qaidam Plates, and the closure of the ocean and the formation of mountains during the Early Ordovician, about 490-413 million years ago. This area, with alpine vegetation and rich biodiversity is the source of many distributaries of the River Heihe.

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Nine rows of pine trees are a natural scenic site in the Chinese Yugur Customs Corridor and many visitors are attracted here to see the marvellous alpine vegetation. Three distinct planation surfaces are evident at this site.

Residual peaks of Danxia landform in Binggou area

Kanbula Apiring Geopark, China - Asia

Fantastic Kanbula Geopark

Shenbao Snow Mountain. The altitude of the main peak is 4,612 metres above sea level. The perennial snow does not change, an unchanging silver light. According to folklore, shenbao is the ninth son of the animal Qing mountain god, Huadan, and gives the mountain its name.

The Yellow River. TheYellow River is the fifth longest river in the world and the second longest river in China. It is an ideal location for geoscientific research and highly valuable for popularizing science.

Lijiaxia reservoir, a tranquil lake on a plateau. It serves the largest double-row hydropower station in the world, mainly for power generation. It also functions for irrigation and flood control. Visitors can take a boat trip to enjoy the scenery of the lake and the dam.

Kanbula Geopark is located in the Huangnan Tibetan Autonomous Prefecture of Qinghai Province of the People's Republic of China, Its geographic coordinates are 101°38 '02 "-102 °11' 05" E, 35°00 '14 "-36 °10' 12" N, with a total area of 3,136.95 km². It is separated by approximately 1,350 km from the capital Beijing and by 100 km from Xining. The Geopark is located in the northeast margin of the Qinghai-Tibet Plateau, the south bank of the upper reaches of the Yellow River, and the eastern foot of Shenbao-Xiaqiong Snow Mountain. In terms of climate, it is characterized by a cool and semi-arid climate on a plateau, with long windy winters, short and cool summers, and distinct dry and wet seasons, with long periods of sunshine and high rates of evaporation.

Kanbula Geopark is located at the junction of three orogenic belts: West Qinling, South Qilian and East Kunlun. It belongs to the transition zone of the Zeku foreland basin of West Qinling and magmatic arc of south Qilian. The unique geographical location and complicated geological processes have created the Geopark's rich and distinctive geological heritage. Kanbula Geopark, as a comprehensive Geeopark, integrates the Maixiu ancient volcanic group, the profile of Triassic strata at Longwu River, the landslide group along the Yellow River, the ophiolite at Longwu Canyon, the Danxia landform, medium and small-sized geological structures, and scenic river landforms etc. The globally exceptional ancient volcanic group of the Maixiu region, formed in a central-fissure eruption in the Qinghai-Tibet Plateau intraplate. It is the largest and best preserved volcanic group, with numerous volcanic features in the Qinghai-Tibet Plateau which formed in the Mesozoic Era. The Triassic strata sequence at Longwu River, with a thickness of nearly ten thousand metres, records the palaeogeographic evolution of Indosinian sedimentary rocks of the central orogenic belt in the tectonic junction area of Qinling Mountains, Qilian Mountains and Kunlun Mountains. The Yellow River is the fifth longest river in the world and the second longest river in China. The uplift of the Qinghai-Tibet Plateau and the headward erosion of the Yellow River led to the formation of geological features such as landslides, Danxia landforms and terraces. It is an ideal location for geoscientific research and highly valuable for the popularization of science. In addition, The Regong Culture and Art Corridor integrates Regong art, Tibetan customs and natural scenery, making the Geopark the Tibetan cultural centre in the region of Amdo.

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UNESCO Global Geoparks

What is a UNESCO Global Geopark?

UNESCO Global Geoparks are single, unified geographical areas where sites and landscapes of international geological significance are managed with a holistic concept of protection, education and sustainable development.

A UNESCO Global Geopark uses its geological heritage, in connection with all other aspects of the area's natural and cultural heritage, to enhance awareness and understanding of key issues facing society, such as using our earth's resources sustainably, mitigating the effects of climate change and reducing natural disasters-related risks.

By raising awareness of the importance of the area's geological heritage in history and society today, UNESCO Global Geoparks give local people a sense of pride in their region and strengthen their identification with the area.

The creation of innovative local enterprises, new jobs and high quality training courses is stimulated as new sources of revenue are generated through geotourism, while the geological resources of the area are protected.

At present, there are 177 UNESCO Global Geoparks in 46 countries.

All the UNESCO Global Geoparks are institutional members of the Global Geoparks Network.

Global Geoparks Network

The Global Geoparks Network (GGN) is a non-profit and a non-governmental organisation. It was initially founded in 2004 as an international partnership developed under the umbrella of UNESCO, and was officially registered as an association in 2014 subjecting to French law. The Global Geoparks Network is the official partner of UNESCO for the operation of the UNESCO Global Geoparks.

Networking and collaboration among Global Geoparks is an important component of the Global Geoparks Network.

The four GGN Regional Geoparks Networks are the Asia Pacific Geoparks Network (APGN), the European Geoparks Network (EGN), the Latin America and Caribbean Geoparks Network (GeoLAC) and the African UNESCO Global Geoparks Network (AUGGN).

www.globalgeoparksnetwork.org

www.visitgeoparks.org

List of UNESCO Global Geoparks

Austria*
1. Styrian Eisenwurzen UNESCO Global Geopark
2. Ore of the Alps UNESCO Global Geopark

Belgium
3. Famenne-Ardenne UNESCO Global Geopark

Brazil
4. Araripe UNESCO Global Geopark
5. Seridó UNESCO Global Geopark
6. Southern Canyons Pathways UNESCO Global Geopark

Canada
7. Stonehammer UNESCO Global Geopark
8. Tumbler Ridge UNESCO Global Geopark
9. Percé UNESCO Global Geopark
10. Cliffs of Fundy UNESCO Global Geopark
11. Discovery UNESCO Global Geopark

Chile
12. Kütralkura UNESCO Global Geopark

China
13. Danxiashan UNESCO Global Geopark
14. Zhangjiajie UNESCO Global Geopark
15. Yuntaishan UNESCO Global Geopark
16. Wudalianchi UNESCO Global Geopark
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18. Shilin UNESCO Global Geopark
19. Huangshan UNESCO Global Geopark
20. Lushan UNESCO Global Geopark
21. Hexigten UNESCO Global Geopark
22. Taining UNESCO Global Geopark
23. Xingwen UNESCO Global Geopark
24. Yandangshan UNESCO Global Geopark
25. Jingpohu UNESCO Global Geopark
26. Leiqiong UNESCO Global Geopark
27. Taishan UNESCO Global Geopark
28. Wangwushan-Daimeishan UNESCO Global Geopark
29. Fangshan UNESCO Global Geopark
30. Funiushan UNESCO Global Geopark
31. Zigong UNESCO Global Geopark
32. Longhushan UNESCO Global Geopark
33. Alxa Desert UNESCO Global Geopark
34. Qinling Zhongnanshan UNESCO Global Geopark
35. Ningde UNESCO Global Geopark
36. Leye Fengshan UNESCO Global Geopark
37. Tianzhushan UNESCO Global Geopark
38. Hong Kong UNESCO Global Geopark
39. Sanqingshan UNESCO Global Geopark
40. Shennongjia UNESCO Global Geopark
41. Yanqing UNESCO Global Geopark
42. Mount Kunlun UNESCO Global Geopark
43. Dali-Cangshan UNESCO Global Geopark
44. Dunhuang UNESCO Global Geopark
45. Zhijindong Cave UNESCO Global Geopark
46. Arxan UNESCO Global Geopark
47. Keketuohai UNESCO Global Geopark
48. Guangwushan-Nuoshuihe UNESCO Global Geopark
49. Huanggang Dabieshan UNESCO Global Geopark
50. Jiuhuashan UNESCO Global Geopark
51. Yimengshan UNESCO Global Geopark
52. Xiangxi UNESCO Global Geopark
53. Zhangye UNESCO Global Geopark

Croatia
54. Papuk UNESCO Global Geopark
55. Vis Archipelago UNESCO Global Geopark

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56. Troodos UNESCO Global Geopark

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57. Bohemian Paradise UNESCO Global Geopark

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58. Odsherred UNESCO Global Geopark
59. Vestjylland UNESCO Global Geopark

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60. Imbabura UNESCO Global Geopark

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61. Rokua UNESCO Global Geopark
62. Lauhanvuori-Hämeenkangas UNESCO Global Geopark
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France
65. Haute-Provence UNESCO Global Geopark
66. Luberon UNESCO Global Geopark
67. Massif des Bauges UNESCO Global Geopark
68. Chablais UNESCO Global Geopark
69. Monts d'Ardèche UNESCO Global Geopark
70. Causses du Quercy UNESCO Global Geopark
71. Beaujolais UNESCO Global Geopark

Germany*
72. Vulkaneifel UNESCO Global Geopark
73. TERRA.vita UNESCO Global Geopark
74. Bergstraße-Odenwald UNESCO Global Geopark
75. Swabian Alb UNESCO Global Geopark
76. Harz, Braunschweiger Land UNESCO Global Geopark
77. Thuringia Inselsberg-Drei Gleichen UNESCO Global Geopark
78. Ries UNESCO Global Geopark

Greece
79. Lesvos Island UNESCO Global Geopark
80. Psiloritis UNESCO Global Geopark
81. Chelmos Vouraikos UNESCO Global Geopark
82. Vikos - Aoos UNESCO Global Geopark
83. Sitia UNESCO Global Geopark
84. Grevena Kozani UNESCO Global Geopark
85. Kefalonia-Ithaca UNESCO Global Geopark

Hungary*
86. Bakony-Balaton UNESCO Global Geopark

Iceland
87. Katla UNESCO Global Geopark
88. Reykjanes UNESCO Global Geopark

Indonesia
89. Batur UNESCO Global Geopark
90. Gunung Sewu UNESCO Global Geopark
91. Ciletuh - Palabuhanratu UNESCO Global Geopark
92. Rinjani-Lombok UNESCO Global Geopark
93. Toba Caldera UNESCO Global Geopark
94. Belitong UNESCO Global Geopark

Iran (Islamic Republic of)
95. Qeshm Island UNESCO Global Geopark

Ireland*
96. Copper Coast UNESCO Global Geopark
97. Burren & Cliffs of Moher UNESCO Global Geopark

Italy
98. Madonie UNESCO Global Geopark
99. Beigua UNESCO Global Geopark
100. Rocca di Cerere UNESCO Global Geopark
101. Adamello-Brenta UNESCO Global Geopark
102. Cilento, Vallo di Diano e Alburni UNESCO Global Geopark
103. Tuscan Mining Park UNESCO Global Geopark
104. Apuan Alps UNESCO Global Geopark
105. Sesia Val Grande UNESCO Global Geopark
106. Pollino UNESCO Global Geopark
107. Aspromonte UNESCO Global Geopark
108. Maiella UNESCO Global Geopark

Japan
109. Itoigawa UNESCO Global Geopark
110. Unzen Volcanic Area UNESCO Global Geopark
111. Toya - Usu UNESCO Global Geopark
112. San'in Kaigan UNESCO Global Geopark
113. Muroto UNESCO Global Geopark
114. Oki Islands UNESCO Global Geopark
115. Aso UNESCO Global Geopark
116. Mt. Apoi UNESCO Global Geopark
117. Izu Peninsula UNESCO Global Geopark

Luxembourg
118. Mëllerdall UNESCO Global Geopark

Malaysia
119. Langkawi UNESCO Global Geopark

Mexico
120. Comarca Minera, Hidalgo UNESCO Global Geopark
121. Mixteca Alta, Oaxaca UNESCO Global Geopark

Morocco
122. M'Goun UNESCO Global Geopark

Netherlands
123. De Hondsrug UNESCO Global Geopark

Nicaragua
124. Rio Coco UNESCO Global Geopark

Norway
125. Gea Norvegica UNESCO Global Geopark
126. Magma UNESCO Global Geopark
127. Trollfjell UNESCO Global Geopark

Peru
128. Colca y Volcanes de Andagua UNESCO Global Geopark

Poland*
129. Holy Cross Mountains UNESCO Global Geopark

Portugal
130. Naturtejo UNESCO Global Geopark
131. Arouca UNESCO Global Geopark
132. Açores UNESCO Global Geopark
133. Terras de Cavaleiros UNESCO Global Geopark
134. Estrela UNESCO Global Geopark

Republic of Korea
135. Jeju Island UNESCO Global Geopark
136. Cheongsong UNESCO Global Geopark
137. Mudeungsan Area UNESCO Global Geopark
138. Hantangang UNESCO Global Geopark

Romania
139. Hațeg Country UNESCO Global Geopark
140. Buzău Land UNESCO Global Geopark

Russian Federation
141. Yangan-Tau UNESCO Global Geopark

Serbia
142. Djerdap UNESCO Global Geopark

Slovakia*

Slovenia*
143. Idrija UNESCO Global Geopark

Spain
144. Cabo de Gata-Níjar UNESCO Global Geopark
145. Sierras Subbéticas UNESCO Global Geopark
146. Sobrarbe-Pirineos UNESCO Global Geopark
147. Basque Coast UNESCO Global Geopark
148. Sierra Norte de Sevilla UNESCO Global Geopark
149. Villuercas Ibores Jara UNESCO Global Geopark
150. Central Catalonia UNESCO Global Geopark
151. Molina & Alto Tajo UNESCO Global Geopark
152. El Hierro UNESCO Global Geopark
153. Lanzarote and Chinijo Islands UNESCO Global Geopark
154. Las Loras UNESCO Global Geopark
155. Origens UNESCO Global Geopark
156. Courel Mountains UNESCO Global Geopark
157. Granada UNESCO Global Geopark
158. Maestrazgo UNESCO Global Geopark

Sweden
159. Platåbergen UNESCO Global Geopark

Tanzania
160. Ngorongoro Lengai UNESCO Global Geopark

Thailand
161. Satun UNESCO Global Geopark

Turkey
162. Kula –Salihli UNESCO Global Geopark

United Kingdom of Great Britain and Northern Ireland*
163. North Pennines AONB UNESCO Global Geopark
164. North-West Highlands UNESCO Global Geopark
165. Fforest Fawr UNESCO Global Geopark
166. English Riviera UNESCO Global Geopark
167. GeoMôn UNESCO Global Geopark
168. Shetland UNESCO Global Geopark
169. Black Country UNESCO Global Geopark

Uruguay
170. Grutas del Palacio UNESCO Global Geopark

Viet Nam
171. Dong Van Karst Plateau UNESCO Global Geopark
172. Non nuoc Cao Bang UNESCO Global Geopark
173. Dak Nong UNESCO Global Geopark

*** List of transnational UNESCO Global Geoparks.**

Austria & Slovenia
174. Karawanken / Karavanke UNESCO Global Geopark

Germany & Poland
175. Muskauer Faltenbogen / Łuk Mużakowa UNESCO Global Geopark

Hungary & Slovakia
176. Novohrad-Nógrád UNESCO Global Geopark

Ireland & United Kingdom of Great Britain and Northern Ireland
177. Cuilacagh Lakelands UNESCO Global Geopark

GLOBAL GEOPARKS NETWORK

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How Geoparks can contribute to the International Geodiversity Day?
Watch the video and find exceptional examples
of the UNESCO Global Geoparks' rich geodiversity

https://globalgeoparksnetwork.org/?page_id=2934

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of insular and coastal areas.

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