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Origins and evolution of geo-biodiversity of Iglicioara Quarry, Tulcea County

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Abstract

The research underlying the project focuses on the area surrounding the Iglicioara Quarry Turcoaia, Tulcea. The aims of the study is to provide an interpretation panel that captures the origin and evolution of the geology in the area, that allows the formation of a soil rich in nutrients which further allowed the flourishing of a rich biodiversity. The panel promotes Iglicioara Quarry's biodiversity and contributes to raising awareness in local communities and visitors. The panel is placed at the visitor center of Macin Mountains National Park, in Greci, in order to increase visibility on the evolution of the area surrounding Iglicioara Quarry.

Introduction

This paper aims to promote the local biodiversity by pointing out the interaction with the geological substrate. The geological settings of this area shaped the existence and evolution of the specific species, both flora and fauna. Through promotion of the local biodiversity, we refer to raising awareness and educating the public and visitors including local communities. Also by promoting this evolution of the area we emphasize that exploitation is a present need necessary for improvement of the quality of life. This project aims to bring public awareness on the processes that favored the development of this area in geological time. The result of these physical and geological processes that have characterized this area hundred of million years ago, led to the economic potential of the area by mining and infrastructure development at national level.

Research methods

The field research consists of all the techniques and methods used to obtain data, comments on the type of the rocks investigated, data about their environment. In order to obtain better results, we chose to compare the biodiversity from Iglicioara Quarry with the one from Bujoarele Quarry. Thus, thin sections samples were collected from both Iglicioara Quarry and Bujoarele Hill. The field application was correlated with other activities in the project (regular meetings, realization of the proposed activities).

The photos on the field application were made with a camera Canon 60D with Canon EF 18-55 IS and Canon EF-S 55-250mm f / 4-5.6 IS STM camera lenses. Laboratory samples were photographed with a Panasonic DMC-L1 camera with macro lens Olympus Zuiko 35mm Macro using a tripod Kaiser and thin sections were photographed Carl Zeiss Axio microscope at a Scope.A1 with Canon digital camera, connected to a graphics station that uses a dedicated software by Carl Zeiss.

Laboratory stage involved processing samples collected from the field (petrographic analysis and thin sections, biodiversity inventory, data that led to the creation of interpretation panel). Subsequently, the raw data were processed as described in the form of summaries, analyzed, interpreted and conclusions were drawn.

Geological settings

Iglicioara Quarry is situated in the southern part of Turcoaia commune, on the right Danube's river bank. From the geological point of view this quarry is part of the North Dobrogea Orogen, which has a hercinic basement penetrated by hercinic and alpine igneous rocks, involved in early alpine tectogenesis events which caused expansion phenomena from Late Permian to Middle Triassic, followed by compressive moves in the Late Triassic-Middle Jurassic interval (Seghedi, 2001). The tectonic units of the North Dobrogea Orogen were settled in two tectogenesis phases: the Old Cimmerian tectonic phase from Triassic-Jurassic limit, and the New Cimmerian phase from Lower Cretaceous. Although the North Dobrogea Orogen contains hercinic and caledonian rock structures, given the fact that the last tectonic movements occured in the Early Alpine Orogeny, the age of North Dobrogea Orogen is alpine.

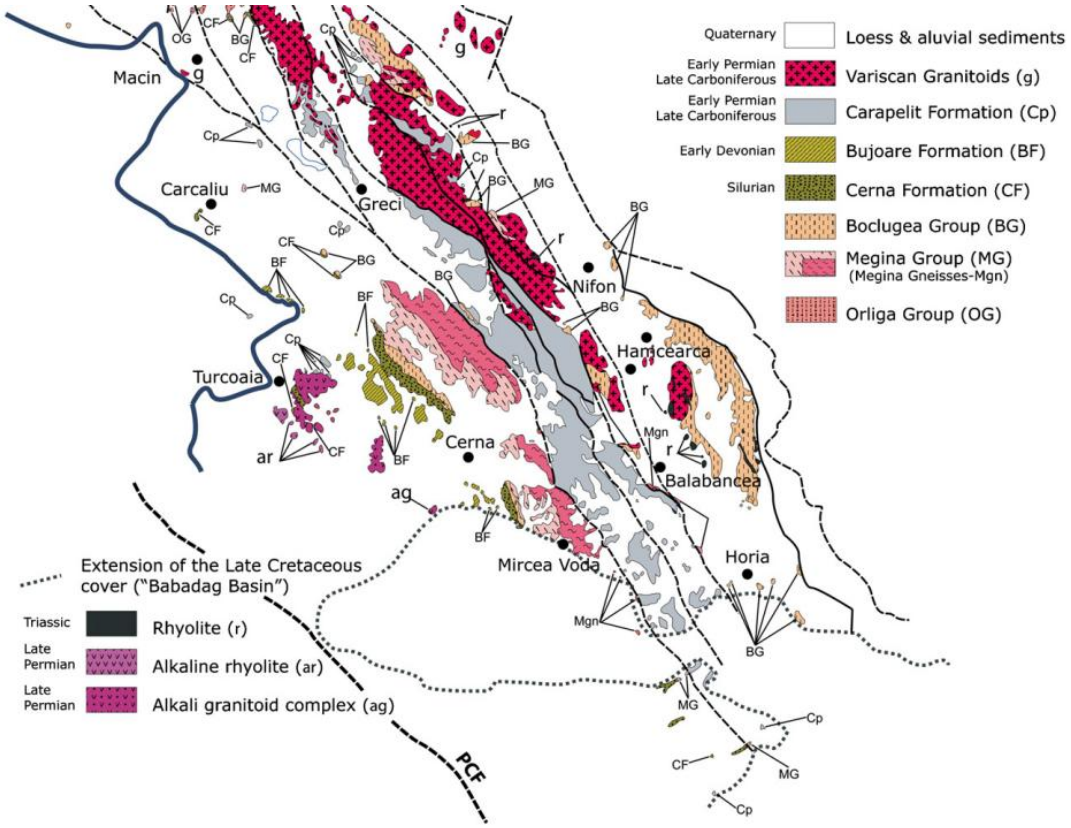
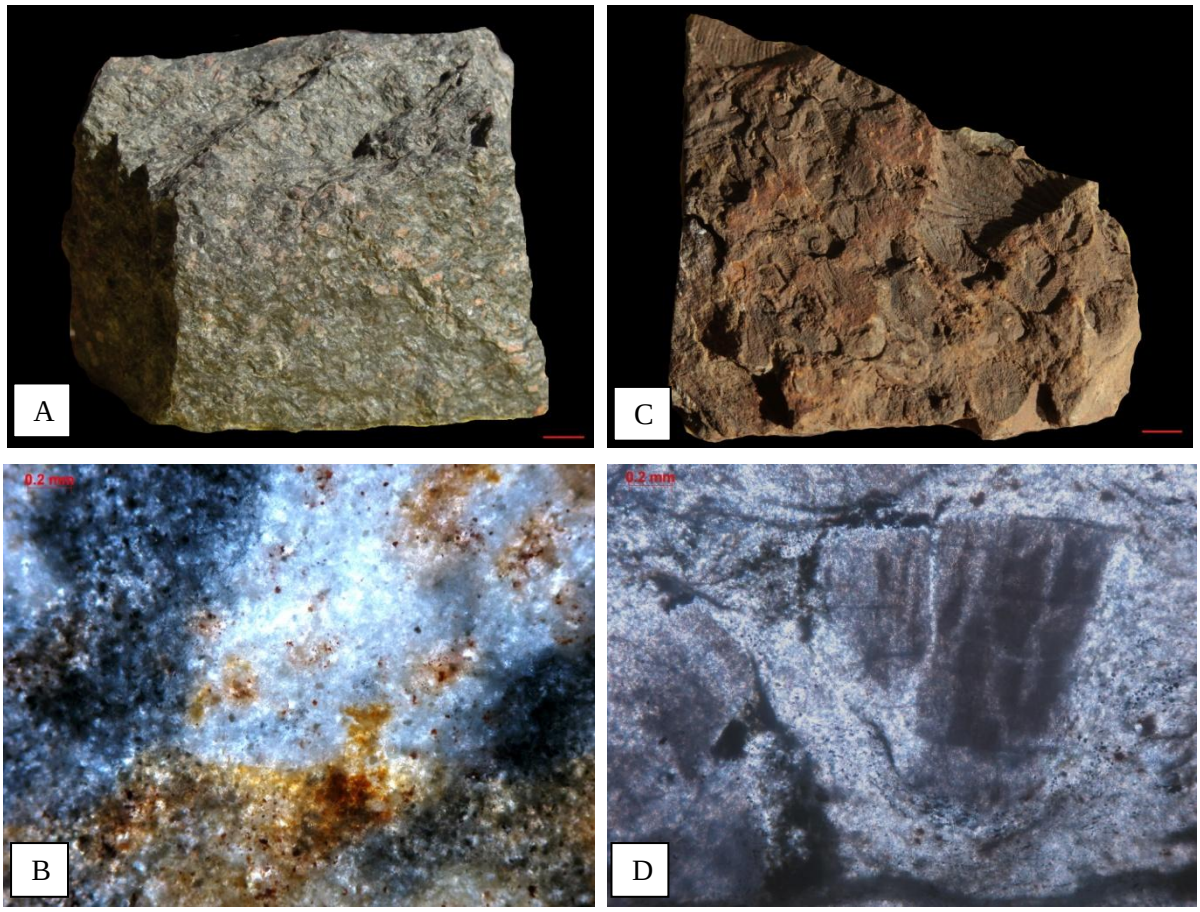


Figure 1 – Geological map of the North Dobrogea Orogen (Balintoni et al, 2010)

The rocks from the Turcoaia massif are represented by alkaline granite and rhyolites (quartztic porphyry) (text Fig. 2 A-B). The age of these rocks was described as Late carboniferous (Săndulescu, 1984), However, a Late Permian Ar-Ar age was yielded by riebeckites from the Turcoaia massif (Seghedi, 2012, after Teleman, unpublished data).

Bujoarele Hill is located in the South-West of Măcin tectonic unit, between Iacobdeal granite and Priopcea crest. From a geologic point of view, it is also a part from the North Dobrogea Orogen, with the

same basement characteristics and affected by the same tectonic moves.The Bujoarele formation is made of quartzites, shales and limestones. The limestones contains fossils (Text Fig. 2 C-D), have breccia aspects and dark grey colour or ferruginous, mostly made of calcite and angular quartz crystals. The rusty aspect is given by the limonite and hematite content.



Text-Figure 2 – (A) Quartzitic porphyry from Iglicioara quarry; (B) Thin section through a quartzitic porphyry hand specimen from Iglicioara quarry; (C) Limestone with fossil corals, bivalves and tentaculites from Bujoarele quarry; (D) Thin section through a limestone sample from Bujoaele quarry.

The Devonian age of Bujoarele Formation was established paleontologicaly, with more than 30 described taxa. There were identified a few species of tentaculites (*Tentaculites scalaris*, *Unicornus durus,*), brachiopods (S*chizophoria provulvaria*, *Dalmanella circularis*, *Douvillina interstrialis*), corals (*Cyanthophyllum* sp., *Zaphrentis* sp.), trilobites (*Asteropyge hammerschmidti*), bryozoans, bivalves and crinoids (Iordan, 1974).

In terms of geomorphology the studied area is defined by the alpine relief type, with rocky sharp picks. The weathering processes are still active with numerous erosion marks creating the unique patchy landscape.

Biodiversity

Both flora and fauna of these two quarries depends and are influenced by the geological aspects that determined the particularities of this ecosystem.

Flora. In Iglicioara Quarry and surroundings there were identified numerous plant species. The vegetal carpet is made up of species of Gramineae, such as *Festuca valesiaca* (Volga fescue), *Poa bulbosa* (Bulbous bluegrass), *Agropyron cristatum subsp. pectinatus* (Crested wheat grass), *Dichantium ischaemum*, *Cynodon dactylon* (Dog's tooth grass). There was also reported the presence of other species of herbaceous plants, some ruderal, segetal or without conservation or pastoral value, but some valuable from a medicinal and aromatic point of view: *Cichorium intybus* (Chicory), *Chondrilla juncea* (Rush skeletonweed), *Xeranthemum annuum* (Immortelle flower), *Plantago lanceolata* (Plantain), *Consolida regalis* (Field larkspur), *Papaver rhoeas* (Poppy), *Echium vulgare* (Viper's bugloss), *Dianthus carthusianorum* (Carthusian Pink), *Verbascum phlomoides* (Mullein), *Cardaria draba* (Whitetop), *Taraxacum officinale* (Dandelion), *Convolvulus arvensis* (Field bindweed), *Achillea millefolium* (Yarrow). Among the vulnerable species of plants there were identified: *Euphorbia milii* (Christ thorn).

Herpetofauna. There were seen several amphibian species: *Bufo bufo* (Common toad), *Lacerta viridis* (European green lizard) and *Testudo graeca ibera* (Spur-thighed tortoise). The spur-thighed tortoise is one of five species of Mediterranean tortoise, from Testudinidae Family, very well known in Romania, especially in Dobrogea area. According with IUCN Red List, at the European level this species is considered as Vulnerable, based on population declines in the last years. We found it very easily, in open habitat, observing both adults and juveniles. The colour of juveniles is much more lighter than the colour of adults.

Avifauna. Iglicioara quarry area is extremely rich in terms of avifauna, this area being ideal for bird watching. Among the protected species of wild birds in Romania and identified in the field we can include: *Ciconia ciconia* (White Stork) - A31 code, *Merops apiaster* (European bee-eater), *Corvus frugilegus* (Rook), *Ardea cinerea* (Grey heron). Other species identified into the area are: *Galerida cristata* (Crested lark), *Passer domesticus* (House sparrow), *Miliaria calandra* (Corn bunting), *Columba palumbus* (Common wood pigeon), *Cuculus canorus* (Common cuckoo). In the southwest part of the quarry there can be seen nests made in sand by the Sand martins (*Riparia riparia*). We could distinguish between predatory species: *Falco tinnunculus* (Common kestrel).

Mammals. In the area there were seen also some mammal species like: *Erinaceus concolor* (Southern white-breasted hedgehog), *Talpa europaea* (Mole), *Lepus europaeus* (European hare).

Results and discussions

We have chosen to present the results of the research through an interpretive panel (Appendix I), which was placed at the visitor's center of Macin Mountains National Park to increase visibility and awareness for the visitors coming at the center, but also for the local communities. The purpose of presenting an

interpretive panel was to educate visitors in a scientific manner, which involves discovery, curiosity from the visitors, not scientific information presented in a didactic approach.

Interpretation has been defined by Freeman Tilden: "*Interpretation is an educational activity which aims to reveal meanings, relationships and contexts by using examples of objects and real phenomena that can be observed directly by using suitable media terms, which is more effective than the mere transmission of factual information. Interpretation is revealing a truth that lies behind some descriptions of facts, interpretation should stimulate curiosity for enriching the spirit and mind* "(Tilden, 1977).

"*Interpretation provides information that aims to facilitate understanding and appreciation of some specific components and natural values, while education provides direct information to increase the level of knowledge needed in the educational process*." ANZECC (1999).

"*Interpretation is a communication process, designed to share meanings and relationships between components of natural and cultural heritage to the public by creating a personal experience developed around natural objects, plants, landscapes or places*" (Freeman Tilden, 1977).

For achieving the panel we applied the six principles of interpretation enunciated by Freeman Tilden (1957):

- Any interpretation that does not make the connection between what is shown or described and the personality or experience of the visitor will be sterile;
- Information is not interpretation. Interpretation is revelation based upon information. But there are different things. However, the interpretation includes information;
- Interpretation is an art that combines many arts, whether the materials presented are scientific, historical or architectural. Any art, to a certain extent can be learnt;
- The main purpose of interpretation is not instruction, but provocation;
- This interpretation should be targeted to the whole rather than a specific part and must address the whole not a phase;
- Interpretation addressed to children (say up to age 12) should not be a dilution of the presentation made for adults, but must have a completely different approach. To make things perfect, it needs a whole new separate program.

Revealing scientific information to non-specialist visitors who would not appreciate an element of geo-diversity or biodiversity only for its intrinsic value, through interpretation, the scientific information is "translated" into a language familiar to visitors, interpretation resorts to emotion and prior knowledge of the visitors, so they are challenged and their interest and curiosity is aroused. After awakening the interest on a specific GEOSIT, visitors are likely to want to know more about the subject. In this case are

particularly useful QR codes linking to a site where interested visitors can find more information (presented in all possible manners similar to their knowledge). Being more interested in the subject, the will to preserve and conserve the site will grow and they can even participate in volunteering activities that support the protection and conservation of the site or make donations to support this. In addition, understanding and with the interest aroused for the particular GEOSIT, because of the interpretation, visitors can be led to a career in Earth Science or Biology or to a retraining based on the principles of interdisciplinarity.

Interpretation suggests two directions, one relating to sustainable development (ecotourism, geotourism) by attracting visitors and one to education (children and adults are challenged to learn more about the scientific information about protecting sites, discovered through interpretation, they also can apply to faculties with this scope).

Classical methods of interpretation include interpretation panels, leaflets, brochures, publications, web resources, guides. Scientific information must be always updated and of great quality and transposed into a language understandable to visitors. Ideally, visitors should be involved in the interpretation process, especially efficient are interactive installations and experimental interpretation centers in places where geodiversity elements are interpreted in situ. In producing materials the following observations must be taken into account: visitors remember only 10% of what they hear, 30% of what they read, 50% of what they see, 90% of what they do (Veverka, 1994).

Therefore we presented on the panel the geological evolution of the area which led to the rich biodiversity of the territory around Iglicioara career (also the Turcoaia Hill Bujoarele). The theme of the panel is: a billion-year-story career of Iglicioara Quarry which makes development of life possible in the area.

Objectives for the panel

- Learning Objective: visitors can appoint 2-3 periods in the geological history of the Planet and the today's elements of biodiversity associated to rocks deposited in those periods.
- Behavioral Objective: knowing the history of the Earth during the emergence of elements of biodiversity, we expect visitors to be more careful and directly or indirectly involved in protecting them (voluntary, donations).
- Emotional Objective: knowing, in a friendly manner, about the development of the stages of life in the area, (knowing their origin) we expect visitors to feel closer, to love more the fauna and flora of the area and be determined not to negatively interfere in landscape.

Panel's description

The panel is bilingual, because at the visitor's center of Macin Mountains National Park many international tourists are expected. On the left side of the panel we made a brief introduction where we described the purpose of the panel, introducing the three specific basis of interpretation: challenge the visitor, calling the visitor's knowledge and revelation of scientific information. A diagram appears in the

middle of the panel illustrating in 3D the geological evolution of the Planet in which we aim to help visitors understand the geological time scale. On the right side of the panel are both paleoenvironments drawings specific to the two geological moments occurring in the field (Devonian and Carboniferous), and texts - one short description of the atmosphere and biodiversity of those moments. At the bottom of the panel we linked the geological moments and the rocks mineralization which made possible the adaptation of species that create the landscape. In the Iglicioara quarry the most numerous species are *Dianthus nardiformis (Pl. I), Carduus nutans (Pl. I), Argynnis paphia (Pl. II) and Galerida cristata (Pl. II). In Bujoarele quarry we found Potentilla emilii-popii (Pl. III), Testudo graeca ibera (Pl. IV), Xarenthumum annuum (Pl. III) and Euchloe ausonia* (Pl. IV). These species are nor rare nor endemic but the ones that define the landscape.

Conclusions

After studying the specific literature, during the research phase on field and laboratory, we created the interpretation panel, which is today at the visitor's center of Macin Mountains National Park.

Placing the panel with the research results at the National Park's center, we promoted the biodiversity of Iglicioara Quarry area, but we also contributed to the education of the visitors. Both tourists and local community members will aknowledge the origins of biodiversity in the Turcoaia - Bujoarele Hill Area, will also understand the importance and value of Macin Mountains' geology, not just in terms of age, but because of its development and of the present benefits for biodiversity and hence for the people. Because if those specific geological process wouldn't have happened in geological time, the rich soil wouldn't have existed and the biodiversity would be missing.

The biodiversity of the area is closely linked to the geologic settings that influenced this ecosystem both in terms of natural and economic.Thus, the steppe vegetation from this area, rich in herbal plants, was adapted to the geological substratum leading to flora peculiarities.

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Appendix I

Povestea de milioane de ani a Dobrogei de Nord

The Ancient Story of Northern Dobruja

Povestea carierei Iglicioara este veche de milioane de ani, dar face viața posibilă azi. V-ați gândit ce drum au avut de parcurs plantele și animalele Dobrogei de Nord ca să ajungă astăzi lângă dumneavoastră? Cercetând rocile expuse de carieră am păstruns în istoria locului.

Rocile Munților Măcin care formează substratul biodiversității au vârste de sute de milioane de ani. Urmărind istoria evoluției Pământului, cele mai vechi roci din zonă au în jur de un miliard de ani (1 Ga). Peste ele, sunt depuse roci mai noi, de 400 milioane de ani (400 Ma) pe care vă invităm să le explorați în situl paleontologic „Dealul Bujoarele" și roci de 360 milioane de ani (360 Ma) care au definitivat peisajul din zona comunei Turcoaia. Cele mai noi roci întâlnite aici, sunt loessurile.

În anumite zone, precipitațiile, vântul și alte fenomene meteorologice au dus la degradarea acestor roci la suprafață și transformarea lor în sol. Multe plante și animale s-au adaptat acestui tip de sol, devenind specii reprezentative ale biodiversității Munților Măcin.

Iglicioara Quarry has a story of millions of years, making life possible today. Have you ever thought about the long way the plants and animals of Northern Dobruja had to go to get so close to you today? By researching the rocks exposed by the quarry, we uncovered the history of this place.

The rocks of the Macin Mountains, which form the substrate for today's biodiversity, are millions of years old. Tracing the evolutionary history of the Earth, the oldest rocks from the area are around 1 billion years old (1Ga). Over them, newer rocks are deposited, of 400 million years old (400 Ma), which we invite you to explore at the paleontological site "Bujoarele Hill". On the next layer, there are newer rocks dating back 360 million years, which defined the landscape (from the area) of Turcoaia village. The newest rocks found here are named loess. In some areas, rainfall, wind and other meteorological phenomena have led to the degradation of the surfaces of these rocks, and their transformation into soil. Many plants and animals have adapted to this type of soil, becoming representative species for the biodiversity of the Măcin Mountains.

Mai multe informatii online / More information online:

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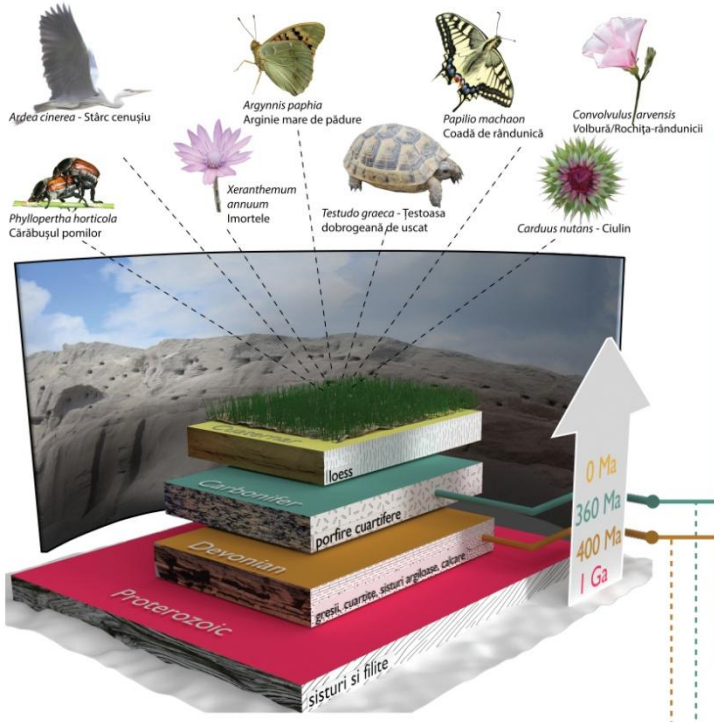
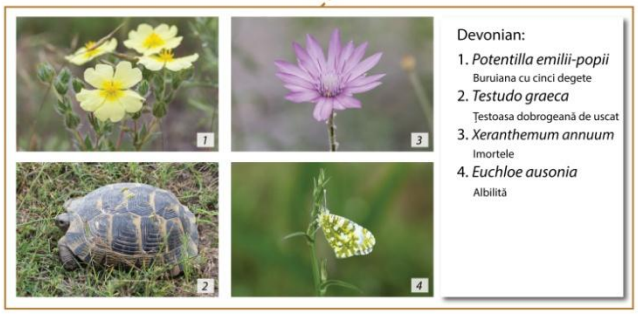


Carbonifer
Facem un salt de 100 de milioane de ani în istoria timpului, depășind atmosfera tropicală și ajungem în perioada glaciară numită Carbonifer (358 milioane de ani). Uscatul era colonizat de adevărate păduri de ferigi arborescente și de strămoșii coniferelor actuale prin care mișunau libelule cât oamenii, scorpioni gigantici și primii gândaci de bucătărie!! Dimensiunile fantastice ale speciilor se datorau concentrației mari de oxigen, eliberat în atmosferă de către plante.

Making a 100 year old leap in the history of time, we go past the tropical atmosphere and reach the glacier era named Carboniferous (358 million years ago). The dry land was colonized by forests of arborescent ferns and by the ancestors of today's conifers, where dragonflies as tall as humans, huge scorpions and the first cockroaches swarmed. The enormous dimensions of the species were due to high concentrations of oxygen which was released into the atmosphere by plants.

Devonian
Acum 419 de milioane de ani începea ceea ce specialiștii numesc perioada Devoniană. Viața pe uscat era aproape imposibilă (plantele încă nu formau păduri care să asigure oxigenul), însă în mări diversitatea plantelor și animalelor era semnificativă. Într-o atmosferă tropicală, primii pești de pe Pământ dădeau adevarate lupte pentru supraviețuire. Ignorând lupta, o parte din ei au început să dezvolte caractere de adaptabilitate pentru viața pe uscat.

419 million years ago began what experts call the Devonian period. Life on dry land was almost impossible (plants didn't form forests to provide enough oxygen to support life), but in the seas the diversity of plants and animals was significant. In a tropical atmosphere, the first fish on Earth were desperately struggling to survive Some of them, ignoring their peers struggle , began to develop adaptation traits in order to live on dry land.



Devonian:
1. *Potentilla emilii-popii*
   Buruiana cu cinci degete
2. *Testudo graeca*
   Țestoasa dobrogeană de uscat
3. *Xeranthemum annuum*
   Imortele
4. *Euchloe ausonia*
   Albilită

Carbonifer:
1. *Dianthus nardiformis*
   Garofiță pitică
2. *Carduus nutans*
   Ciulin
3. *Argynnis paphia*
   Arginie mare de pădure
4. *Galerida cristata*
   Ciocârlan

PLATE I

Dianthus nardiformis

Carduus nutans

PLATE II

Argynnis paphia

Galerida cristata

PLATE III

Xeranthemum annuum

Potentilla emilii-popii

PLATE IV

Euchloe ausonia

Testudo graeca