Concepts of geoparks establishment in Bulgaria and their geothermal resources

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Abstract. Bulgaria is the third country in the world by number of mineral springs after Japan and Iceland. The Bulgarian-Russian collaboration in geological, environmental and landscape conservation provided a new development of the methodology for identification, evaluation and characterization of geodiversity including their geothermal resources. Individual approach to the concepts of the national geoparks stressed on their scientific and geodiversity features, environmental conditions and economic premises by defining one major geopark theme and many minor topics. Regardless of their radically different themes, the geothermal activity in geoparks is the common feature, which provides them with a great balneological potential. The concept of Geopark “Iskar Canyon” is based on the remarkable geodiversity of the Iskar River Canyon with a number of wonderful landscapes and scenic outcrops of various rock types ranging from Precambrian to Quaternary. The concept of Geopark “Belogradchik Rocks” lies on the famous Lower Triassic sandstone pinnacles. Geopark “Rila” is based on its remarkable glacial landscapes - glacier valleys, cirques, moraines, arêtes and horns. The major theme of Geopark “Burgas Lakes” is related with the ancient sea-level changes and balneo-healing properties of their humus mud. The unifying theme of these geoparks is the high spa potential of their thermal springs that have been used since the Roman Age.

1. Introduction
UNESCO Geoparks initiative is designed to set up a world network of nature parks where “significant geological features” are recognized. Its original purpose was to integrate geoconservation with biological conservation envisaged to be under the exclusive authority of the government in the country where they are situated. After the founding of the European Geoparks Network (EGN) this initiative encouraged identification of geodiversity in many nature parks with established infrastructure, budget and management plans to provide a geological framework of their natural heritage. UNESCO Executive Board at its 160th session in 2000 declared that geological heritage promotion is an important recognized need and an alternative to the World Heritage List is required for the recognition of geological/geomorphological sites of national, regional and international importance that may not rank as of World Heritage value. In other words, geoparks are proposed as an alternative UNESCO designation because not all of the world’s scientifically or historically important geosites could meet the ‘outstanding universal value’ criterion required by the 1972 UNESCO World Heritage Convention [1]. Although the UNESCO geosites/geoparks programme was not endorsed by the UNESCO Executive Board in 2001, the EGN signed an official agreement of collaboration with UNESCO and placed the network under the auspices of UNESCO. In 2004 the Global Geoparks Network (GGN)
was founded under the auspices of UNESCO with three main goals: conserving a healthy environment, education about Earth Sciences to the wider public and fostering sustainable local economic development.

Bulgarian geoconservation is oriented to identification of geodiversity in perspective geopark areas with pure geological features without a status of nature or national parks. Such areas with significant geological heritage not having administrative infrastructure, management plan and government financial support, have faced serious difficulties in applying for the EGN, because the development of new protected areas is rather long and difficult process, especially when the concerned category is not covered by national legislation. The UNESCO International Geoscience and Geoparks Programme (IGGP, 2015) gave a new impetus to the geoparks development and inspired a new approach to the geodiversity identification and evaluation of geosites, especially in a geopark environment. The newly established National Council of geodiversity and geoparks, following to the recommendation of IGGP, took the initiative to develop a new methodology for the assessment of geosites and to build a new national strategy for the development of a National Geoparks Network.

Bulgarian-Russian collaboration in geological, environmental and landscape conservation revealed similar problems and perspectives of the national policies on conservation of geological heritage, and led to a new development of geoconservation theory and practice. Despite the radically different circumstances, due to the scale of work in both countries, a new development strategy was created including common approach and integrated methodology for assessing and characterization of geosites in park environment, not only for geoparks, but also for nature and national parks.

The subject of the present paper is the new development of the methodology for identification, evaluation and characterization of geosites in park environment. In the focus of the present analysis are the newly applied individual approaches to the development of national geoparks concerning the concept of each geopark, depending on its geodiversity and geomorphological features, environmental conditions, social circumstances, and economic premises in the context of their geothermal and balneological potential. The main difference of the new methodology compared to the previous developments is the identification of one major theme for each geopark and an individual approach to the classification of geosites depending on their relation to it. As far as Bulgaria is the country with the most thermal springs in the world after Japan and Iceland, special attention is paid to the geothermal features of each geopark which is the unifying theme of the Bulgarian geoparks and provides them with a high spa potential that have been used by people since the Roman Age.

2. Short history of the Bulgarian geoparks
The idea of creating a global network of geoparks arose in 1996 in a discussion between G. Martini and N. Zouros at the 30th International Geological Congress held in Beijing during the symposium on the protection of the geological heritage [2]. The initiative of creating UNESCO geoparks was announced at the ProGEO’98 Meeting in Belogradchik, Bulgaria. It was conceived as a program which acts in the framework of two internationally agreed action plans. This initiative was launched to create a UNESCO GEOARK Programme “in response to the numerous requests from the Member States expressing their interest in improving the international recognition of their national geological heritage” [3].

Geoparks establishment in Bulgaria started in the frame of the project for developing the Register and Cadastre of the Bulgarian geological phenomena in 1999. The scientific fundament of the first Bulgarian geopark was developed in 2002 when Geopark “Iskar Gorge” was presented at the 3rd European Geoparks Meeting in Eggenburg, Austria [4]. During the development of the Register and Cadastre was declared that Bulgaria has areas with outstanding geological features which need to be united in geoparks with significant geological heritage, instead of transformation of natural parks into geoparks with the only purpose to use their infrastructure for easier application in EGN. This concept was based on the principle of the “thematic geodiversity”: one leading theme at the heart of the geopark concept, and secondary topics with different themes reflecting the area's geodiversity. Evaluation of the geosites was based on a statistical method of estimation based on 16 criteria of
significance, developed especially for the Register and Cadastre [5]. Regardless of the large number of criteria, this method is suitable for assessing national geodiversity but is not particularly applicable in a park environment with more specific requirements for geosites.

The National Council for geodiversity and geoparks continues to hold the geoconservation policy set out in the Register’s concept of developing genuine geoparks with a remarkable geological heritage instead of adapting natural parks to geoparks because of their infrastructure and state support, ensuring easier application for UNESCO Global Geoparks. Areas with significant geological heritage without such administrative advantages have faced serious difficulties in applying for EGN members, because for most countries the development of new protected areas is rather long and difficult process, especially when the concerned category is not covered by national legislation.

Bulgarian geoconservation has faced this problem passing through two failed applications of Geopark “Belogradchik Rocks” in NW Bulgaria, which is part of the most underdeveloped region in Europe – Vidin district. Regardless of its remarkable geological and cultural heritage, methodologically developed scientific dossiers of 72 geosites of aesthetic, scientific and cultural value, it has become an example of an unsuccessful geopark application of area with a century-old tradition in preserving and promoting its geological heritage. This problem should be resolved in the way satisfying both national geoconservation strategy and local stakeholders, because another unsuccessful EGN application will turn public opinion towards “We are happy with our current status, we don’t need UNESCO”.

3. Geoparks concepts

3.1. Geopark “Iskar Canyon”

The first Bulgarian geopark “Iskar Defile” (“Iskar Gorge”) established in the frame of the project for elaboration of “Register and Cadastre of the Bulgarian geological phenomena” funded by the Ministry of Environment and Water was developed according to the concept based on the remarkable geodiversity of the Iskar Canyon providing picturesque landscapes and wonderful outcrops of various rock types ranging from Precambrian to Quaternary (Figure 1).

Despite of its high scientific and scenic value geopark “Iskar Gorge” remained in a working version due to lack of funding and disagreement between the stakeholders and the decision makers. This remarkable geomorphological formation is located on the territory of three municipalities that cover most of the Iskar Canyon, crossing the Balkan Mountain between the city of Sofia and Mezdra town. The original idea for creation a National Geopark called “Iskar Defile” was elaborated according to the European and world tendencies at the beginning of the century. The geopark database was developed on the basis of geological information compiled from 22 geotopes included in the National Register and Cadastre of the Bulgarian geological phenomena accompanied by scientific dossiers of another 16 geosites, representing sites of scientific value: key sections of stratigraphic boundaries and units, outcrops of igneous bodies, fossil deposits and thematically linked outcrops (geotrails).

The main theme of the geopark is the canyon formed by Iskar River after the drainage of the Sofia Lake to the sea located on the territory of the Moesian Platform in the middle of the Dacian Stage about 4,5 million years ago. Now Iskar River takes its source from Rila Mountain, the highest mountain on the Balkans, crosses the Balkan Mountain through the picturesque Iskar Canyon, then the Moesian Platform and flows into the Danube.

Iskar Gorge offers a number of scenic landscapes and remarkable rock outcrops of various metamorphic, igneous, volcanic and sedimentary rocks, representing the whole Phanerozoic history of the Earth: Riphean-Ordovician greenschist Diabase-Phyllitoid Complex, Ordovician, Silurian and Devonian rocks including graphitic black shales with fossil deposits (Figure 2), Ordovician/Silurian and Silurian/Devonian boundaries, Llandovery/Wenlock and Ludlow/Pridoli boundaries, Carboniferous anthracite coal deposits with well preserved stems of lepidophytes (Figure 3), sphenophyllales and ferns, continental terrigenous and volcano-sedimentary Permian deposits, complete Triassic section including the famous Buntsandstein facies and Alpine Triassic carbonates,
representative Jurassic sections with “Ammonitico Rosso” and “Black Jurassic” facies, Jurassic/Cretaceous boundary, Lower Cretaceous Urgonian facies, Mediterranean volcano-sedimentary and North European epicontinental type Upper Cretaceous, Cretaceous/Tertiary boundary iridium layer, Paleocene, Eocene and Neogene sediments of various facial types, and different genetic types of Quaternary deposits.

Figure 1. Rock arc of Triassic carbonates in the Iskar Canyon near Lakatnik village, Sofia District

Unexpectedly, in 2018 the bottom-up initiative for establishment of geopark under the name “Iskar Canyon” was reinforced by three Iskar municipalities: Svoge, Mezdra and Novi Iskar, which is constituent of the big metropolitan municipality of Sofia. This initiative is supported by the Ministry of Environment and Water and the newly created National Council of geodiversity and geoparks. Regardless of the time lost, this area has an enormous geotourist potential, due to the remarkable morphological landforms of scientific, cultural, socio-economic and scenic type and the proximity to the capital city. With a responsible geoconservation activity and proper management approach this potential could be developed in a modern and attractive geological park.

Figure 2. *Oktavites spiralis* – Silurian graptolith from Svoge area published in National Geographic

Figure 3. Stems of *Calamites* and *Lepidophytes* in 300 million years old sandstone near Svoge

Balneological aspects. Sofia, the capital city of Bulgaria, inherited a settlement created around the thermal sources during the Bronze Age. The mineral terms have always been in the focus of the
antique and medieval town, called Serdika and Sredets, preceding the modern capital city. During the Roman epoch the mineral terms attracted many Roman rulers as well as common citizens and military veterans of the Roman legions. Due to its balneological preconditions in third century Serdika became the capital city of the Roman province Dacia Aureliana. Now the numerous mineral sources and baths in the city and its surroundings, which are part of the Bulgarian geological and cultural heritage (Figure 4), are an important part of the main theme of Geopark “Iskar Canyon” contributing to the tourist potential of the city with a reserved place in the geopark logo. Not least are the numerous karst springs some of which are widely known as for example Zhitolyub spring (Figure 5).

3.2. Geopark “Belogradchik Rocks”

The concept of Geopark “Belogradchik Rocks”, considered the most famous geological monument in Bulgaria, is based on the beautiful rock pinnacles formed in the Lower Triassic red sandstones (Figure 6), complemented with a remarkable geodiversity of sedimentary, igneous, volcanic and metamorphic rocks. There are dozens of geosites that correspond to the context of the main theme of the Geopark: geological phenomena, landscapes and their relation with the antique and medieval human history, summarized in 72 well illustrated scientific dossiers. The pearl of the geopark, the famous Belogradchik Rocks, are supplemented by outcrops of various types of rocks ranging from Precambrian to Quaternary, geological phenomena and non-geological themes related to landscape and geology.

The Belogradchik Rocks are the most famous natural landmark in Bulgaria. This spectacular rock assemblage represents imposing rock monuments and a beautiful mountain landscape formed in red continental sandstones and conglomerates referred to the so called “Buntsandstein Facies” deposited in Early Triassic continental rivers. Along a 3 km wide and 18 km long strip numerous impressive outcrops, rock pinnacles and buttes of red rocks are exposed, each of which could be a single geotope outside the area. There are also other famous facies, cycles and events, such as Ammonitico Rosso, Urgonian, Milankovitch climatic cycles, latest Albian ocean anoxic event, Paleocene-Eocene thermal maximum and K/T boundary iridium layer, which is the evidence of one of the greatest cataclysm events in the history of the Earth – the Chicxulub asteroid impact [6].

Along with its remarkable natural beauty, Belogradchik area has a long human history, closely connected to the natural landscape. It dates as far back as the Palaeolithic Period as documented by simple pebble tools, prehistoric graphic art (mural paintings) in Magura Cave, and many relicts of Bronze and Iron Ages. Recent investigations of a Bulgarian-French archaeological team in Kozarnika Cave have led to a discovery of continental and global significance, testifying for earliest migration of humans from Africa to Europe.
Figure 6. Belogradchik Rocks are remarkable rock pinnacles in red Lower Triassic sandstones and conglomerates that have been formed for more than 35 million years.

The Belogradchik fortress on top of the monument field served various garrisons for many centuries since Roman Age. Now the rocks are a majestic background of the summer festival of the Sofia Opera and Ballet „Opera of the Peaks – Belogradchik Rocks” where spectacles are performed in the open air inside the Belogradchik fortress and Wagner's music sounds in the concert hall of the Magura Cave (Figures. 7,8). This wonderful idea attracts many visitors from the country and abroad contributing to the promotion of the natural and cultural potential of the Belogradchik Rocks.

Geopark “Belogradchik Rocks” passed through unsuccessful applications for Global Geoparks in 2010 and 2015. According to the recommendations a new concept of the geopark was developed including establishment of a management body, expanding of the geopark area, and scientific characterization of geosites of aesthetic, scientific and cultural value. Since then geopark has come a long way to its present state of Aspiring UNESCO Geopark. A management body of the geopark was established - nongovernmental Association for Development of North-West (ADNW) including three municipalities: Belogradchik, Dimovo and Makresh.

Over the past four years the geopark area has undergone significant development. First of all a solid geodatabase was developed, including geodiversity characterization, scientific dossiers and geological map of the area in ArcGIS. The new concept of the geopark is developed on a strong agreement between the participating municipalities, state support of the geopark activities, clear geopark funding, management plan for developing of the geopark area, sustainable regional development policy strategy and importance of geotourism and other alternative forms of tourism (ecotourism, rural tourism, cultural tourism) for the local economy.

2018 marks the 20th anniversary since the public announcement of the UNESCO Geopark Initiative at the ProGEO’98 meeting in Belogradchik. It was marked by an international scientific conference entitled “Geoparks and Modern Society” that was attended by representatives of 4 continents (Figure 9) [7]. Participants became acquainted with typical local flora and fauna in the Natural Museum and the exceptional geological diversity of the West Balkan Mountain in the new Geological museum arranged in the Geopark building including rocks of all types and ages from Precambrian to Recent (Figure 10). Several geosites in the frame of the town were visited among which the emblematic medieval Belogradchik fortress and antique Roman stronghold build on inaccessible higher part of the rocks (Figure 11).
Field excursions represented remarkable geological and cultural diversity of the area, which can rarely be seen in a single geopark. Participants visited outcrops of Precambrian ophiolitic complex, Lower Paleozoic cumulative gabbro, ultrabasite and keratophyre, Variscan brittle-ductile shear zone, Carboniferous lepidophytes and ferns, Jurassic petrified trees, Mylankovich climatic cycles recorded in epicontinental Upper Jurassic limestones, the iridium layer deposited after the meteorite impact at the end of Cretaceous, widely known as “the asteroid that killed the dinosaurs”, and many other geological phenomena.

Unforgettable visits of Kozarnika and Magura caves left the unique feeling of one of the most important events in Europe’s prehistoric history - they sheltered the earliest European citizens who came from Africa 37 000 years ago during the Würm Ice Age. In the Magura Cave are preserved famous Paleolithic mural paintings which are part of the world cultural heritage (Figure 12). Along with prehistoric human artifacts, fragrant local wines can be tasted, including naturally sparkling wine aging in one of the cave halls.

Balneological aspects. Compared to the other geoparks reviewed in this paper the mineral sources in Belogradchik area are rare. Here several mineral springs are preserved from the Roman Age in the surroundings of Belogradchik, Kula, Slanotran and Granitovo. Unfortunately the mineral sources in the area are not in use due to the worsened economic situation in Northwest Bulgaria.
3.3. Geopark “Rila”

The glacier formations are at the base of the concept for the development of Geopark “Rila”. Despite the low geodiversity of the mountain, glacial landforms give an alpine shape to its relief and high aesthetic value to the mountain landscapes. The remarkable glacial landforms - horns (carlings), arêtes, cirques, glacier valleys, moraines, drumlins, etc., drastically changed the higher parts of the mountain during the Quaternary glacial ages (Figures 13, 14). They are also affected by the modern geocryogenic processes, which further shape the fossil glacial landforms. The well expressed fossil glacial relief of Rila inherited from the Quaternary glaciations, provides unlimited possibilities for interpretation of the varied glacial processes for the general public. The development of promotional materials and their presentation in an attractive and accessible way for the tourists will increase the public awareness of Rila's geological history and the opportunity to develop sustainable all-season tourism.

Along with the typical glacial formations, periglacial landforms are also an integral part of the general concept for development of Geopark Rila [8]. The effects of freezing and thawing drastically modify the ground surface in a periglacial environment. Types of modification include the displacement of huge amount soil materials, rock boulders, and the formation of unique landforms.
The periglacial morphostructural landforms are gradually superimposed on the fossil glacial relief of the mountain modelling it by fragmentation of the bedrock and formation of cryonival cirques, scree slopes and cones. Each of these forms can be presented to the visitors in an attractive way through information boards with schematic interpretations, graphics and photos in an accessible for the wide public language. An important stage in the interpretation of geocryogenic processes for the

![Figure 13. Paternoster cirque “7 Rila’s Lakes” carved in Precambrian metamorphic rocks](image13)

![Figure 14. Big Malyovitsa Cirque surrounded by carlings and periglacial moraines (scree cones)](image14)

![Figure 15. Roche moutonnée in serpentinized ultrabasite near Trefoil Lake, 7 Rila’s Lakes](image15)

![Figure 16. Rila Monastery, an emblematic Bulgarian spiritual site founded in 10th century](image16)

![Figure 17. The only geyser on the Balkans in the town of Sapareva Banya](image17)

![Figure 18. Mineral waters of Sapareva Banya are used for spa treatment since 6000 years](image18)

The periglacial morphostructural landforms are gradually superimposed on the fossil glacial relief of the mountain modelling it by fragmentation of the bedrock and formation of cryonival cirques, scree slopes and cones. Each of these forms can be presented to the visitors in an attractive way through information boards with schematic interpretations, graphics and photos in an accessible for the wide public language. An important stage in the interpretation of geocryogenic processes for the
purpose of geotourism is their differentiation from the fossil glacial landforms and the demonstration of the results of their influence on the Wurm glacial relief. Places where modern geocryogenic processes now operate are at an altitude higher than 2000 m.

Viewing the most characteristic supraglacial forms - the cryogenic cirques and supraglacial moraines, it is difficult to set the boundary between glacial and post-glacial activity. For that reason, the periglacial landforms provide a wide field for demonstrating the results of the typical glacial activity during the Würm Ice Age and recent frost weathering modifying the high mountain relief.

In this aspect, a retrospection of the most frequent landforms of frost weathering with an emphasis on accessible and demonstrable sites with well-developed periglacial processes and phenomena in the most visited higher parts of Rila Mountain is the right approach for development of thematic geotrails in the context of the main theme of Geopark Rila.

On the background of the impressive alpine landscapes and remarkable geomorphological diversity, the petrographical diversity of the mountain looks relatively poor. However, Rila Mountain is built of various Upper Cretaceous and Paleogene granitoids and partially of motley and diverse Neoproterozoic metamorphic rocks cropping out in its northern, western and southern parts, which represent significant petrographical diversity that was a subject of long petrographic investigation starting in the middle of the eighteenth century.

Rila is composed mainly of granitoids belonging to the Rila-West Rhodopean Batholith, the largest batholith on the Balkan Peninsula. It is characterized as a complicated igneous massive, with four phases of magmatic activity [9]. The first phase includes rocks of granodiorite to quartz-diorite composition, forming several separate bodies. During the second phase, medium and coarse-grained biotite granites are introduced, which are most widely represented within the batholith forming four bodies situated around the bodies of the first phase. The third phase includes fine-grained granites to plagiogranites, forming several small bodies. Their contacts with the host metamorphic rocks and granitoids of the earlier phases are intrusive. The fourth phase is represented by aplitoid and pegmatoid granites forming small stock-like bodies or veins. This petrographic review reveals unlimited possibilities for interpretation of the igneous processes.

The metamorphic rocks cropping in the mountain are also very divers. They are reviewed in two ways: as lithotectonic units and in the light of the lithodemic approach for characterization of the metamorphic rocks developed for the purpose of the geological mapping of Bulgaria at a scale 1:50 000 [10]. The variety of the metamorphic rocks in Rila is really remarkable. The oldest Maleshevtsi and Troskovo Metamorphic Complexes are composed of orthometamorphic bodies of amphibolite, metaserpentinite, gneiss-granite, metadiorite and metagabbro. The younger Rupchos and Predela Metamorphic Complexes are composed of all metamorphic varieties described in the petrographic literature: biotite and two-mica gneisses, muscovite-albite gneisses, migmatitic gneisses, gneiss schists, distene-sillimanite and kyanite schists, amphibolites, biotite and two-mica leptynites, serpentinites, serpentinitized ultrabasites, metagabbro, eclogites, marbles etc. Some of the famous Rila’s tarns – the Seven Rila’s Lakes, the most visited place in Rila Mountain, are developed in the rocks of the Chepulare motley metamorphites of the Rupchos Metamorphic Complex (Figure 15). In the tarns of the Urdini Lakes, which are developed in the same unit, emerald (precious variety of beryl) containing pegmatite veins are available, crossing intensively folded carbonate-silicate schists with skarn mineralization of metasomatic minerals of the garnet group (grossular, andradite), vesuvianite, scapolite and epidote. Here is also established one of the most precious and rare minerals in the world – chrysoberyl. Chrysoberyl (alexandrite) is rarer than diamonds and is one of the most expensive gemstones in the world.

The remarkable geomorphological and petrographical diversity is complemented with an extraordinary cultural and spiritual heritage. At the foot of the mountain is situated the medieval Rila Monastery (Figure 16) founded in 10th century, which is included in the World Heritage List. Several geotrails with historical value for the Bulgarian geology and culture are under development. The longest one (69 km) is the so called “Kaiser’s Road” through which Kaiser Wilhelm II and Tzar
Ferdinand passed during 1917. Another geotrail is of cultural, historical and spiritual value including Rila Monastery and the cave where its founder St. Ivan Rilski died on 18 August 946.

Balneological aspects. The slogan of Geopark “Rila” is “land of iron and water”, because of the medieval crafts developed on iron extraction from magnetite placers in Rila rivers, and the connection of the mountain with the three aggregate states of the water: 1) it is the source of many rivers including the longest river on the Balkans – Maritsa River and has more than 200 glacial lakes (liquid phase), 2) its Quaternary glacial history (solid phase) and 3) the numerous thermal springs including the only geyser on the Balkans (vapor phase) which is the hottest geyser in Europe with a temperature of vapor 101.3°C - about 20 degrees higher than the Iceland geysers (Figure 17). It serves for heating of the public buildings in the town of Sapareva Banya. The mineral water is hyper-thermal, poorly mineralized with a very good effect on the diseases of the locomotory system, the nervous system, skin and gynecological diseases. Geothermal activity in Rila is manifested along the faults around the mountain. The active tectonic movements caused the elevation of the mountain during the Miocene-Pliocene time to become the highest mountain on the Balkans (2925 m). There are hundreds of thermal springs surrounding the central massive of the mountain. They have been used for spa and healing procedures for thousands of years (Figure 18). Here are preserved ruins of many Roman baths that attracted not only Romans, but also Thracians, Byzantines, Slavs, Bulgarians, etc.

3.4. Geopark “Burgas Lakes”

The main theme of Geopark “Burgas Lakes” is related with the ancient sea-level changes and marine terraces marking high sea levels during the Quaternary history of the Black Sea [11]. Burgas Lakes Complex, comprising three firths (limans) and one lagoon, is situated on the territory of Burgas and Pomorie municipalities. Ramsar sites and dune habitats are subject of intensive research due to the rare and protected inhabiting species.

Figure 19. Along with its balneo-healing importance the Pomorie lagoon is an important ramsar site which is part of Via Pontica – one of the major migration routes of birds from Europe to Africa

These biotopes are the link between geodiversity and biodiversity within the lake complex with a high potential for geomorphosites and geo-ecotrails to be developed for geotourism purposes. The Burgas Lakes Complex is an important ramsar site which is part of the so called “Via Pontica”, the antique Roman route near the Black Sea which is now used to designate one of the major migration routes of birds from Europe to Africa (Figure 19).
Important part of the regional geodiversity according to the main geopark’s theme are the old marine terraces outlining ancient shorelines of the Black Sea basin: the Nymphean, the Neochernomorian, the Karangatian, the Early Euxinian and the Chaudinian. They are represented by flattened erosional surfaces (erosional terraces, Figure 20) or sediments (accumulative terraces) dated on the basis of rich bivalvian fauna.

Figure 20. Neochernomorian terrace situated 4 m above the present sea level incised in Upper Cretaceous volcanic rocks at Foros Cape

Figure 21. Type locality of Upper Cretaceous pillow lavas near Bulgarovo village defined as a separate rock type called “bulgarite”

Figure 22. Fossil caldera in the crater of the Upper Cretaceous Zidarovo volcano

Figure 23. The border shaft “Erkesia” between Bulgaria and Byzantium build in 9th century

Figure 24. Burgas mineral baths offers a complex hyper-thermal mineral water therapy, lagoon mud and sea lye treatment

Figure 25. Balneohotel Pomorie situated between the Black Sea and Pomorie Lagoon offers spa procedures with lagoon mud and sea lye
The area comprises several geosites included into the Register and Cadastre of the Bulgarian geological phenomena, such as the iridium layer at the Cretaceous-Tertiary boundary near Kozichino village, the Upper Cretaceous pillow-lavas near Bulgarovo village representing a separate rock type called “bulgarite” (Figure 21), dune sands at Alepu, Gradina and Kavatsite as well as several geosites of erosional and abrasional origin as Dobrovan mushrooms near Sini Rid village, Priest’s Rock near Fazanovo village, Kolokita Peninsula south of Sozopol, Agalina Cape, and others.

An important part of the geological heritage of the area are the residual volcanic craters and calderas, remnants of the Upper Cretaceous volcanic activity (Figure 22). Many outcrops of Mesozoic and Paleozoic rocks are located in Strandzha Mountain on the territory of Sredets Municipality. Although not in the context of the main theme of the geopark, they successfully complement the remarkable geodiversity of the area and offer interesting themes for geological interpretation, as for instant volcanic activity in South Bulgaria during the Coniacian-Campanian interval of the Late Cretaceous.

The remarkable geodiversity of the area is complemented with the ruins around the ancient towns Anhialo (Pomorie), Apolonia (Sozopol) and Deultum (Debelt) testifying to the long history of life on the Black Sea coast. The altitude of the antique Roman port Deultum at the ancient shoreline of Mandra Bay, proved by archeological artifacts, coincides with the altitude of the Neoeuxinian marine terrace situated 4 m above the present sea level. An important artifact preserved from the First Bulgarian State is the 142 km long border shaft between Bulgaria and Byzantium built in 9th century between Mandra Lake and Maritsa River during the reign of Tsar Petar (Figure 23). This facility marks the state border between the two countries according to the Peace treaty signed between Bulgarian Khan Omurtag and Byzantine Emperor Leo V the Armenian during 815-816.

The preview of the geological and cultural arguments for geopark establishment reveals that the Burgas region has a great potential for development of geosites of scientific, aesthetic, ecological and cultural value related to the main theme of the geopark - sea level changes, that could be used to demonstrate to the wide public what is the real global warming and how it reflects on the sea level and the ancient human settlements.

The establishment of a geopark on the Black Sea coast will add this unique sea to the European Geoparks Network and will expand its geography to the lullaby of the ancient European civilization – Pontus Euxinus.

Balneological aspects. The Burgas Lakes Complex offers unique maritime conditions for humus mud and sea lye treatment. The bedrock of the area, represented by Upper Cretaceous volcanic rocks, is penetrated by dozens of mineral thermal sources, which have been used for balneo- and medicinal bath therapy for centuries. Burgas Mineral Baths (Figure 24) is known since the Neolithic time. In the 3rd century BC it was visited by Philip II of Macedon, the father of Alexander III the Great. Later it was turned into Roman Mineral Baths “Aque Calidae” (Hot Waters). The mineral water has a temperature of 41°C and has excellent drinking qualities. It is suitable for the treatment of diseases of the musculoskeletal system, nervous system, gynecological diseases, etc. Due to the close proximity to the Black Sea, Burgas Mineral Baths offer a complex hyper thermal mineral water therapy, liman mud and sea lye treatment. There are also spa centers, resort polyclinic, hydrothermal pools, sanatoriums, etc.

Ultrasaline natural lagoons (Pomorie Lake) and limans (Atanasovsko Lake) of the Burgas Lake Complex are centers of the Bulgarian mud and lye balneo-treatment. The lake mud and lye contain all elements and micro elements of sea water – potassium, sodium, calcium, magnesium, iron, copper, zinc, strontium, etc., which have a multiple effect with thermal, chemical and mechanical factors, along with the so called “black beaches” composed of magnetite enriched sands, that reach a temperature of up to 60°C below the summer sunshine. The Black Sea beach in Geopark Burgas Lakes offers a world-unique combination of thermal mineral water, sea lye, lagoon/liman mud, sunshine and hot black sands.
4. Conclusions

Geoparks development requires scientific multidisciplinary and international approach aimed at a professional identification of geodiversity in areas perspective for preservation, promotion and sustainable use of the geological heritage. Only in this way the main goal of the geoparks can be realized - to stimulate the socio-economic development of the regions through geotourism and other forms of sustainable tourism without restrictions on traditional activities.

Geoparks development in Bulgaria has gone its way from the beginning of the initiative to the present following the principle of the “thematic geodiversity” – identification, promotion and preservation of geodiversity in perspective geopark areas with significant geological features. The concepts of the Bulgarian geoparks are based on one major theme to which other secondary topics are subjected. They include local traditions and customs. The main theme of each geopark, regardless of its geological significance, must be related to the local lifestyle and culture. The variety of themes adds quality to the geodiversity, but leaves visitors out of the main idea, so balanced approach is used, including the relationships between local traditions and geological heritage. Clear demonstration of the main theme is desirable to be represented at most geosites.

The assessment of this long period of search and challenges is contradictory. Twenty years after the scientific development of the first Bulgarian geopark, the country still has no UNESCO geopark. However, as well as 20 years ago, when the original scientific methodology for evaluation of geosites was developed, the Bulgarian geoconservation does not stop looking for its own way in realizing its original approach based on the remarkable geological and geomorphological diversity of the country.

Recently new approaches and new methodology for evaluation of geosites in a geopark environment according to the main features of each region is develop. It is adjusted to be consistent with the main theme of each geopark and also to be relevant to the national priorities such as social addressing and tourism development. It should also include some unifying natural characteristic that highlights the national affiliation of the geoparks. In Bulgaria there are many thermal mineral springs and their presentation as attractive representatives of the national geological heritage is an important element of the geoparks concepts. Although it is not a major topic in any of the geoparks reviewed in this paper, the theme of the thermal springs is an important link between them, and between geology and ancient history of the Bulgarian lands.

The performances of the Sofia Opera and Ballet in the open air inside the Belogradchik fortress transform the Belogradchik Rocks that are part of the Global geological heritage, into a scene of the World cultural heritage. The major theme of Geopark “Burgas Lakes” - the ancient sea level changes, is close to the main livelihood of the local population – the costal tourism. Relationships between geology and local crafts in the past is demonstrated in the slogan of Rila Geopark “land of iron and water”. It includes the memory for the primitive iron extraction and forging crafts, with which the area was known in the Middle Ages. The water in its three aggregate states – ice (Quaternary glaciations), steam (geysers and thermal springs) and the present water source giving rise to many rivers is at the base of the concept of Rila Geopark. The long geological history of the Iskar Canyon is complemented with scenic outcrops and cliffs. All these geoparks are thematically linked by the remarkable thermal activity, providing unlimited possibilities for spa and balneo-tourism.

Development of thematically oriented geoparks, based on the principle of the “thematic geodiversity” is an unconventional approach, with its advantages and disadvantages. Bulgarian-Russian collaboration in geological, environmental and landscape conservation revealed new perspectives for the development of this approach in both countries for the purpose of the national policies in the field of conservation of the geological heritage, and led to a new development of geoconservation theory and practice.

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