The Geological Heritage of Bulgaria (overview)

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Introduction

The protected natural sites of Bulgaria belong to different groups mostly of geomorphic character: caves, waterfalls, upright rock columns, soil and rock pyramids, upright rock walls, rock mushrooms, rock bridges, rock rivers, karst sources, karst dolines, gorges, rockfalls, moraines, separate rock sculptures, dunes, extinct volcanoes, fossil sites, mineral sites. Some of the significant geological sites are included within the boundaries of greater reserves or parks. Lakes and marshes are protected mostly because of their value for the biological diversity, and are not included in our list of the geological sites. The full list consists of about 370 sites, and is not published here. Lists of the protected sites have been previously published in the Review of the Bulgarian Geological Society by Spasov (1966) and Todorov (1976, 1981, 1990). In the present paper, we will draw the attention towards the most valuable sites, and will analyze the character of the protected sites by groups.

Geological sites under protection

The following table shows the distribution of the protected geotopes in different groups of geological and geomorphic character.

<table>
<thead>
<tr>
<th>No</th>
<th>Character of the geotope</th>
<th>Number of sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Karst: caves, karst sources, karst dolines</td>
<td>124</td>
</tr>
<tr>
<td>2</td>
<td>Rock formations:</td>
<td></td>
</tr>
<tr>
<td></td>
<td>complex rock formations, rock haloes, rock walls</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td>rock &quot;pyramids&quot;</td>
<td>31</td>
</tr>
<tr>
<td></td>
<td>rock bridges</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>gorges</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>different rock formations (separate cliffs, &quot;mushrooms&quot;, columns)</td>
<td>74</td>
</tr>
<tr>
<td>3</td>
<td>Waterfalls</td>
<td>71</td>
</tr>
<tr>
<td>4</td>
<td>Limans and other sea formations</td>
<td>6</td>
</tr>
<tr>
<td>5</td>
<td>Fossil sites</td>
<td>9</td>
</tr>
<tr>
<td>6</td>
<td>Mineralogical and petrological sites</td>
<td>3</td>
</tr>
<tr>
<td>7</td>
<td>Important geological sites as petrified forests, columns of unknown origin, etc.</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>358</td>
</tr>
</tbody>
</table>

Mountain) are protected. The protection of palaeontological and mineralogical sites is unsuccessful: practically all protected sites have been plundered and devastated by collectors, tradesmen and tourists.

Selected geotopes under State protection

Most of the geotopes under State protection have a geomorphic character but some of them possess features of a complex geological and geomorphologic significance. A brief description of the most important among them is schematically given in the following lines. The location of the corresponding geotope on Fig. 1 is marked with a number in brackets. The sites of Veliko Turnovo (capital of the Second Bulgarian Kingdom, 1185-1393) and Madara
(the Madara Horseman, a bas-relief from the end of the Seventh-beginning of the Eighth Century, First Bulgarian Kingdom) are protected as archaeological and cultural monuments but have also a geomorphologic value. The sites of Cherven (mediaeval town of the Second Bulgarian Kingdom) and Ivanovo (monasteries and churches from the Second Bulgarian Kingdom made into natural and artificial caves on the cliffs) are under State protection as archaeological monuments, and are located within the Natural Park “Rousenski Lom” (under protection as natural monument). The mediaeval town of Melnik and the Rozhen Monastery are situated in the Natural reserve “Melnishki piramidi” and are also protected as archaeological and cultural monuments.

Belogradchik Rocks (“Belogradchishki Skali”) (1)

Situated in and around the town of Belogradchik, West Stara Planina Mountains, Montana District; various rock forms within Permian and Lower Triassic red conglomerates and sandstones (Tzankov, 1995) crowned by Middle Triassic and Jurassic calcareous rocks (limestones and dolomites); protected area ca. 200 hectares. Under protection since 1949.

Capes at the Black Sea coast South of the Stara Planina Mts., Bourgas District (54, 89, 90, 91)

Several rocky capes along the coast are protected in different time. The Cape Emine (54; 0.5 hectares; 1976) is the most protruded one, being the easternmost promontory of the Balkan Range; built up of Palaeogene marine formations. Cape Chervenka (89; 2.1 hectares; 1974) at the village of Chernomoret is built up of Upper Cretaceous volcanic and intrusive rocks. Cape Agalina (90; 31 hectares; 1980) and “Kornyata” (65 hectares; 1970) at Sozopol are other areas with fjords and rock forms in the same complexes. The cape “Maslen nos” (91) at Primorsko (17.6 hectares; 1974) is famous with erosion forms (in Upper Cretaceous volcanics), fjords and the Phoque Cave. The “Lion’s Head” nearby (0.5 hectares; 1974) is built up of monzonites.

“Choudnite skali” (the Marvellous rocks) (35)

Beautiful steep rock cliffs in the Upper Cretaceous limestones with flint nodules near the village of Asparouhovo, Varna District, along the Louda Kamchiya River. Protected on 12.5 hectares since 1949.

“Dervishka mogila” (The Dervish’s Hill), Haskovo District (82)

Situated at the village of the same name, the protected area (33 hectares; 1976) is built up of metamorphic rocks of Precambrian and Triassic age. Famous for the garnet-bearing micaschists.

“Dzhendema” (The Hell), town of Kalofer, Plovdiv District (69)

Reserve (since 1953) on 3290.5 hectares (mostly Palaeozoic granites), enlarged with the reserve “Tuzhansko Zhdrelo” (Tuzha Gorge — 49; near the village of Gorno Sahrane, Stara Zagora area, protected since 1983 over 11.2 hectares) to 4220.2 hectares (1991). Steep cliffs, abysses, various land forms. Waterfall “Rayskoto pruskalo” (The Paradise Sprayer) with a height of 125 m (protected since 1966) at an altitude of 1600 m on the southern slope of the Stara Planina (Balkan) Mountains. Other similar waterfalls are known and protected along the same slope (neotectonic normal fault) near the town of Karlovo and the village of Christo Danovo. The waterfall “Kademliya” (the Lucky Waterfall) near the village of Tuzha is situated at an altitude of 1500 m and has a height of 60 m (protected since 1966 over 1 hectare); small cave and rich karst source. Several other waterfalls are protected in the same area.

Erma Gorge (“Zhdreloto na Erma”) (55)


Kaliakra (Cape) (54)

Situated near the village of Bulgarevo, near the town of Dobrich, Varna District. Steep cliff and cave in limestones; protected on 687.5 hectares since 1966. Important archaeological site, beautiful legends. The “Taoukliman” (The Birds’
Gulf) is another important reserve with many caves and rare birds; situated near the village of St. Nikola, it is protected since 1962 on 89.5 hectares.

Karloukovo Karst Complex (near the village of Karloukovo, Lovech District) (27)

Protected since 1963. Vertical cliffs with picturesque karst forms, caves, and the Prohodna rock bridge.

Kayluka (town of Pleven, Lovech District) (21)

A karst valley with lake in Cretaceous and Neogene limestones proclaimed a park in 1973 over 1000 hectares. Several important fossil sites in marine Neogene deposits are situated around the town of Pleven, these near the village of Yasen (Tortonian; 1972) and the Opanets Hill (Badenian; 1979) being the most famous.

"Kozhouha" (The Fur Coat), Blagoevgrad area, Sofia District (66)

Complex protected site (since 1962) of 0.4 hectares near the village of Karnalovo, Strouma Valley. Volcanic rocks of probable Neogene age, with beautiful erosional landforms and important thermal mineral source. Cave. Marshes on the birds' migratory way Via Aristotelis. Endemic vegetal and animal species. Archaeological sites from Prehistoric, Thracian, Ancient Greek and Roman times.

"Kozyata Stena" (The Goat's Wall) (29)


"Melnishki piramidi" (Melnik Pyramids), Blagoevgrad area, Sofia District (3)

Reserve (architectural and natural) over 1165.5 hectares (since 1960). Beautiful erosion forms (pyramids, coulisses, capped earth pillars, etc.) in Neogene (Maeotian — Romanian) terrigenous continental rocks of the Sandanski and Kalimantsi Formations. Near the reserve are situated rich fossil sites of mammal fauna (Nikolov, 1985).

Muglizh Gorge, town of Muglizh, Stara Zagora area, Haskovo District (50)

Another gorge on the southern slope of the Stara Planina (Balkan) Mountains along the neotectonic Sub-Balkan fault belt. Protected over 238 hectares since 1986. Includes the protected waterfalls “Golemiya skok” (the Big Jump) and “Malkiya skok” (the Small Jump) and the historic locality “Gradut”. Several protected sites near the town, mostly erosional forms in tectonized granites.

Neogene fossil sites, Plovdiv District (70)

Protected sites (since 1968) over a territory of 9100 hectares in the vicinities of the villages Ahmatovo, Bogdantsi, Seltsi, Ezeroto, Byala Reka, Pravoslaven and the town of Popovitsa. Fossil finds of Neogene mammal fauna (Nikolov, 1985), including giant Proboscidia (Deinotherium sp.). Another important site is located near the village of Dorkovo (71), Velingrad area (protected since 1990 over 1 hectare) Bulgarian-French joint expedition found rich taphocoenosis of Pliocene mammal fauna.

Ourdini ezera (Ourdini lakes), Rila Mts., near the village of Govedartsi, Sofia District (62)

Mineralogical complex over 1150 hectares. Protected since 1985. Precambrian (?) metamorphic rocks of the Rhodopian Supergroup (various gneisses, granite-gneisses, marbles, amphibolites, metamorphosed ultrabasics) with desilicified pegmatites (locally emerald-bearing) and skarns; rare mineralizations. Palaeogene volcanic (mostly rhyolite) and sedimentary formations with erosion forms (“pyramids”) in the East Rhodope Mountains, Haskovo District

Several protected geological sites are situated in the Palaeogene sedimentary and volcanic formations near the village of Vulche pole (84). Rock pyramids in Palaeogene rhyolites are protected in the sites “Kovan-kaya” (1 hectare; 1973), “Koush-kaya” (1 hectare; 1973) and “Glouhite kamani” (2 hectares; 1973). The locality “Kovan-kaya” (85) at the village of Dolno Cherkovishte is a vertical cliff in Palaeogene limestone with rock cavities and holes made in Thracian times (1.5 hectares; 1972). Near the village of Surnitsa (80), rock “pyramids” are protected in the localities “Dougan-kaya” (Falcon Rock; 1972; 1.5 hectares) and “Probitiya kamak” (1 hectare; 1974), and the waterfall Dikilitash (0.2 hectares; 1966). The vertical cliffs “Kourt-kale” or “Sheynovets” (83) at the village of Mezek (5 hectares; 1976) are built up of rhyolite tufts.
Fig. 1. Location map for the most important geotopes in Bulgaria. The numbers correspond to the numbers in the geotope descriptions in the text.
transformed in zeolites. Various erosion forms in similar tuffs are protected in the Kurdzhali area at the villages of Beli-plast (81) ("Mantarkaya" — rock mushrooms; 3 hectares, 1974), Zimzelen ("Gelin kayasa", the Petrified Wedding: rock mushrooms; 5 hectares, 1974) and Oustren ("Kaleto": rhyolite neck; 1972). The Petrified Forest (86) at the village of Raven, Kurdzhali area, contains numerous silicified tree stems in Palaeogene rhyolites and tuffs over an area of 7.5 hectares protected in 1970. The Rock Window at the village of Kostino, Kurdzhali District, is a rock bridge in rhyolite tuffs (0.2 hectares; 1979). At the village of Benkovski (88; Kurdzhali District), the "Mushroom" (200 sq.m; 1982) and the "Lion" (1982) are built up of Palaeogene sandstones.

Pirin National Park, Blagoevgrad area, Sofia District (10)

National park (since 1962) with the reserves "Bayuvi doupki — Dzhindzhirtsa", "Yulen", "Orelek", "Tisata", and nearby reserve "Slavyanka — Alibotoush" at the border with Greece. Important protected geotopes (erosion forms, cliffs, waterfalls, glacier lakes and moraines, caves) and still not protected geological sites of special scientific importance (see Zagorchev, 1995).

"Pobitite kamani" (Upright stones, Natural rock columns), Varna District (2)

This is a unique natural phenomenon protected since 1937 on 70 square kilometers near the town of Beloslav and several villages. Proclaimed protected area of international importance in 1995. The erosion formed peculiar natural columns in calcareous sandstones and sandy limestones situated within louse Middle Eocene nummulitic sandstones. First reported during the Crimean war (1856) by the Ship Captain Spratt, these peculiar rocks are the subject of more than 150 publications and nearly 100 hypotheses grouped in several principal groups, and namely: (i) Weathering hypothesis; (ii) Infiltration hypothesis; (iii) Concretion hypothesis; (iv) Biogenic Coral hypothesis; (v) Phytogenic hypothesis (petrified forest); (vi) Bioherm or agglutitherm hypothesis.

Rousenski Lom (Rouse District) (6)

The picturesque valley of the river Rousenski Lom near the villages of Cherven, Koshov, Pisanets, Ivanovo, etc. curves in gorges within Cretaceous limestones with numerous caves and beautiful cliffs. The ruins of the mediaeval town of Cherven (Metropolitan's seat) and the rock churches and monasteries near Ivanovo (in the World Cultural Heritage List of UNESCO) are perfectly inserted in this majestic landscape.

"Sinite kamani" (The Blue Stones) at the town of Sliven, Bourgas District (12)

This park covers 6107.8 hectares (founded 1980) and contains numerous rock phenomena in Permian quartz-porphyries and olistostrom formations of different age (mostly Cretaceous and Palaeogene). Several caves are protected since 1969.

"Smolyanski ezera" (Smolyan Lakes), Smolyan District (78)

Lakes (49.5 hectares; protected since 1982) in Palaeogene terrain in the feet of majestic rhyolite cliffs as "Nevestata" (the Bride — 79), protected since 1987 over 47.7 hectares.

"Stobski piramidi" (Stob Pyramids), village of Stob, Kyustendil area, Sofia District (59)

Beautiful erosion forms (pyramids, coulisses, capped earth pillars) in reddish and yellowish conglomerates and sandstones of Neogene and Eopleistocene age (description in Zagorchev, 1995). Protected since 1964 on 74 hectares.

"Trigradsko zhdrelo" (Trigrad Gorge), Smolyan District (73)

Karst valley with majestic gorge and deep and beautiful abyss cave (managed for tourist visits). Protected since 1966. Marbles of the Dobrostan Formation (Rhodopian Supergroup, Proteozoic). In the same area and rocks: "Dyavolskiya most" (the Devil's bridge — 75) at the village of Borino (rock bridge and waterfall protected since 1978 over 39.8 hectares); "Bouynovsko zhdrelo" (the Bouynovo Gorge — 77) at the village of Bouynovo; "Yagodinska peshtera" (Yagodina cave — 76) at the village of Yagodina (managed for tourist visits).

Veleka Canyon near the town of Malko Turnovo, Bourgas District (93)

Picturesque canyon and gorge of the river Veleka (1546.3 hectares; 1989) in various Mesozoic formations of the Strandzha Mountain.
“Vkamenenata svatba” (the Petrified Wedding), Stara Zagora area, Haskovo District (53)

Erosion forms (over 20 hectares; protected since 1974) near the village of Medovo. Conglomerates and sandstones of Turonian age, with intense Neogene and recent erosion.

Vrachanski Balkan (Sofia and Montana districts) (7)

Park founded in 1989 over 2017.4 hectares. It contains most of the picturesque Iskur Gorge that crosses the Stara Planina (Balkan) Mountain Range North of Sofia towards the towns of Mezdra and Vratsa (Tzankov, 1995). Many important geological sites and picturesque rock forms including steep cliffs, caves and karst areas and sources, rock crowns, etc. The "Ritlite" (17) (Aptian calcareous sandstones forming upright layers eroded and preserved as vertical walls; an area of 160 hectares under protection since 1938; Montana District) and the Lakatnik Rocks (41) with cave and the karst source "Zhitolyub" (93 hectares; protected since 1966, since 1990 included in the park "Vrachanski Balkan; Triassic limestones and dolomites; Montana District) are the highlights of the gorge. Includes also the reserves and protected sites "Vrachanski karst" (reserve over 1430 hectares since 1983), "Novata peshtera" (The New Cave), the cave "Temnata Doupka", the picturesque gorge North of the town of Vratsa ("Vratsata"; 2 hectares; protected since 1964) in Jurassic limestones, the caves "Zmeyova doupka" and "Ledenika", the waterfall Skaklyya (height 139 m; protected since 1978), etc. The cave "Elata" (43) and the picturesque cliff "Dzhouglat"a (42) are also in its proximity along the Iskur Gorge.

Zemen Gorge (between Zemen and Ruzhdavitsa, Kyustendil area, Sofia District) (57)

Picturesque gorge of the Strouma River, mostly in Triassic carbonate rocks (Iskur Carbonate Group: Spathian — Norian). The Zemen Cliffs (dolomites; 13 hectares, protected since 1968) and the Skakavitsa waterfall (58; near the village of Polska Skakavitsa; height of 53 m, protected since 1968; Quaternary travertine over Palaeozoic and Triassic limestones) are the most important sites, and several sites of Special Scientific Importance nearby are still not under protection.

Conclusions

Although the protected geological sites of Bulgaria are numerous and possess a considerable scientific and aesthetic value, they are most often sites of geomorphologic rather than geological significance. Many of them (as, e.g., the Belogradchik Rocks, the Melnik Pyramids, Pirin National Park and the reserves within it, Vrachanski Balkan National Park, etc.) combine important geological and geomorphologic features with biological diversity (endemic and rare vegetal and animal taxa, forests, etc.), archaeological, cultural and historic values, etc. However, the experience in their protection and conservation is often negative, and many of them, including such of international importance, suffered heavy losses and damage due to irresponsible human activity. The next step in geotope conservation should be the elaboration of a national list of geological Sites of Special Scientific Importance, the introduction of these sites within the natural monuments protected by the State, and the establishment of an effective monitoring system (Todorov, 1990; Iliev, Djourova, 1995) for all natural monuments.

References


