

CARTOGRAPHIC SUPPORT OF ASPIRING GEOPARK BELOGRADCHIK ROCKS

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ABSTRACT. The new territory of the first Aspiring UNESCO Geopark in Bulgaria, Belogradchik rocks, comprises three municipalities in Northwest Bulgaria in Vidin region between Bulgarian-Serbian border and the Danube. The new concept of geopark emphasizes the importance of geotourism and other alternative forms of sustainable tourism. Tourism activities can actively promote to get acquainted with geologic and landscape features of the region. In relation to the main objectives of the proposed geopark we have elaborated a new informational support based on geospatial data and thematic maps. These data can be organized in three blocks: base geospatial data, thematic data and tourism data. Base data include digital elevation model, hydrography, populated places, road network and so on. Thematic maps relate to geologic and landscape diversity and reflect geologic structure, locations of geosites, landscape types, land cover classes according to CORINE landcover 2012 and areas of high nature value. Tourism data comprise georeferenced bicycle routes, pedestrian tracks and ecological tracks. All these geospatial data have been compiled in the single geodatabase and visualized at a scale 1:300 000.

Key words: aspiring geopark Belogradchik rocks, geospatial data, thematic maps, natural landscape, land use, tourist routes, tourist attraction

КАРТОГРАФСКА ПОДДРЪЖКА НА КАНДИДАТСТВАЩИЯ ГЕОПАРК БЕЛОГРАДЧИШКИ СКАЛИ

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РЕЗЮМЕ. Територията на първия кандидатстващ в ЮНЕСКО български геопарк Белоградчишки скали включва три общини от Видинска област - Северозападна България между Сръбско-Българската граница и р. Дунав. Новата концепция за геопарка набляга на важноста на геотуризма и другите форми на устойчив туризъм. Туристическите дейности могат активно да насърчават запознаването с геоложките и ландшафтни особености на района. Във връзка с основните цели на предлагания геопарк е разработена нова информационна основа, базирана на геопространствени данни и тематични карти. Тези данни могат да бъдат организирани в три блока: основни геопространствени данни, тематични данни и туристически данни. Основните данни включват дигитален височинен модел, хидрография, населени места, пътна мрежа и т. н. Тематичните карти се отнасят до геоложкото и ландшафтното разнообразие и отразяват геоложките структури, местоположението на геотопите, ландшафтните типове, класовете на почвената покривка съгласно CORINE landcover 2012 и площите с висока природна стойност. Туристическите данни включват геореферирани веломаршрути, пешеходни пътеки и екопътеки. Всички тези геопространствени данни са компилирани в единна геобаза данни и визуализирани в мащаб 1:300 000.

Ключови думи: кандидатстващ геопарк Белоградчишки скали, геопространствени данни, тематични карти, природен ландшафт, земеползване, туристически маршрути, туристически атракции

Introduction

Nowadays there is a quite new nomination standard for inscribing Belogradchik rocks into list of European geoparks. The new nomination standard demands for a necessary set of thematic maps for the territory proposed as a geopark. However there aren't any conventional rules of cartographic support for European geoparks. Besides essential geologic maps some more thematic maps can be proposed for the support of ecotourism and functional zoning at the territory of aspiring geopark. These proposed maps are:

- 1) The map of natural landscapes and objects of high nature conservation value
- 2) Land use/land cover map of aspiring geopark
- 3) Map of tourist routes and different attracted sites for sustainable tourism and geotourism.

Materials and methods

The new three thematic maps for the territory of the aspiring geopark were elaborated by means of different geospatial data in ArcGIS for Desktop software. Initial geospatial data were obtained originally as a scientific results of our perennial and detailed field surveys or imported from open and well-known European and global datasets. All thematic data were organized in three blocks (Table 1). Initial scales of all data are from 1:100 000 to 1:300 000.

All the data were georeferenced, reprojected and compiled in a single geodatabase in the form of thematic layers. It allows to conduct further geospatial analysis and create visualization of data in the form of thematic maps.

Table 1.
Geodatabase of basic and thematic geospatial data for the territory of the aspiring geopark

GIS layers	Source of geospatial data
<i>Basic layers</i>	
isohypses peaks height marks rivers lakes roads rails settlements	Digital elevation model Shuttle Radar Topography Mission (SRTM) 1 Arc- Second Global Topographic maps, scale 1:100 000
Municipalities Border of geopark	GADM database of Global Administrative Areas
<i>Thematic layers</i>	
<i>Geologic and landscape diversity</i>	
<i>Natural landscapes</i>	Remote sensing data (LANDSAT 8 OLI), field survey, original map
Outcrops	Topographic maps, scale 1:100 000
Geologic structures (stratigraphy)	Geologic map of Northwestern Bulgaria, scale 1:100 000 (original map)
Geologic structures (lithology)	Geologic map of Northwestern Bulgaria, scale 1:100 000 (original map)
Objects of high nature conservation value	Natura 2000 data - the European network of protected sites (EEA, 2016)
<i>Contemporary land use/land cover</i>	
<i>Land use types</i>	CORINE Land Cover European seamless 100m raster database CLC12
<i>Tourist infrastructure</i>	
Biking routes of different levels of complexity	Map "Bike trails in western Balkans Bulgaria and Serbia", scale 1:90 000
Ecotracks	Field georeferenced data (GPS tracks)
Geosites of different objective value, incl. cultural attractions	Original field survey, georeferenced data.
Caves	Atlas of caves in Belogradchik region (2009)

Results and discussion

Natural Landscape Map

For the territory of the aspiring geopark 11 types of natural landscapes can be defined based on geologic and geomorphologic general features and peculiarities (Figure 1).

According to the scheme of natural regions (elaborated by Velchev, Todorov and Penin, cited by Penin, 2007) Northwest Bulgaria is divided in four regions: 1, Danubian-Dobrudzhian, 2. South Danubian and Ludogorian, 3. Subbalkanian, 4. Stara Planina.

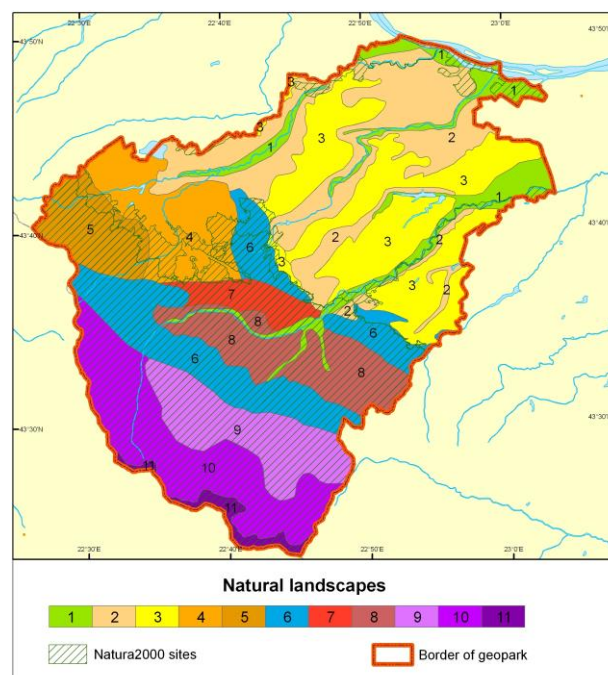


Fig. 1. Natural landscapes and Natura 2000 sites. Initial scale 1:300 000

The two former mentioned natural regions include 3 types of landscapes. The youngest ones are landscapes of contemporary river valleys (Archar, Skomlya, Lom and its tributaries Stakevska and Chuprenska) with alluvial stratified soils under poplar-willow forests (№1 at the Figure 1). Also on the Danube plain we have defined the remnant hilly plains formed on Neogene sandstones with dominantly tilled sod soils (№2) and the landscape of hilly eroded loess plains with black earth under arable lands (№3).

Fore-Balkan region have the highest landscape diversity with 5 types of landscapes. These are: ridged plains on Lower Carboniferous granitoids and argillites with brown forest soils under arable lands and fallows (№4); hilly uplands on Carboniferous carbonate rocks and siltstone with grey forest soils under oak forests with oriental hornbeam (№5); cuestas on Permian and Mesozoic limestones and marls with mountainous rendzines under oak-hornbeam-beech forests (№6); submontane landscapes on Triassic red bed rocks with brown forest soils under oak forests (№7); submontane landscapes on Ordovician conglomerates and schists with grey forest soils under oak forest with rich understory, arable lands and fallows (№8).

Region of Stara Planina encompasses 3 types of landscapes: low mountains on Carboniferous and Permian granites, gneisses with grey forest soils under oak and oak-hornbeam forests (№ 9); middle mountains on Carboniferous and Permian diorites, granodiorites and gneisses under beech and coniferous-beech forests (№10); high mountains on Carboniferous and Triassic crystalline rocks with rankers under subalpine grasslands and shrublands (№11).

Sites of high nature conservation value i.e. Natura 2000 sites are also shown at the landscape map (Figure 1). These sites locate in the southern part of the aspiring geopark in submontane and mountain parts. Natura 2000 sites encompass landscapes of high, middle and low mountains, cuestas and ridged plains. They also include contemporary river valley of Lom in the east and Archar in the west. Part of the Danube valley belongs to Natura 2000 sites. Sites of Natura 2000 represent different and valuable forest habitat. Secondary mixed or oriental hornbeam forests have high scenic value. Primary forests in submontane landscapes (with *Quercus petraea*, *Q. pubescens* and *Q. cerris*) and in middle mountains (with *Picea abies*, *Abies alba*) have high conservational value. Along small river valleys primary small-leaved forests (with poplar and willow) are conserved.

Land use/land cover map

Contemporary land use/land cover map is created according CORINE Land Cover dataset (2012) (Figure 2). CORINE land cover classes can be interpreted as functional land use types with regard to landscape structure and economic specific of the geopark's territory.

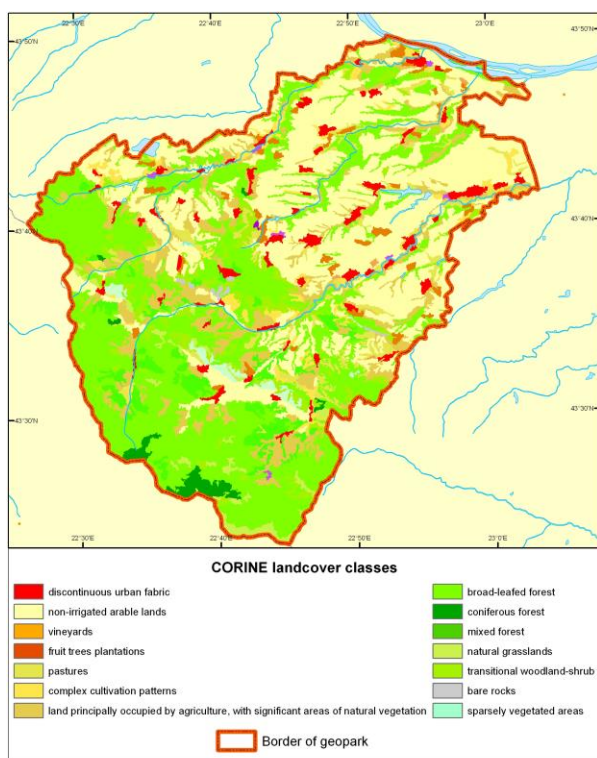


Fig. 2. Contemporary landcover (according to CORINE landcover dataset, 2012). Initial scale 1:300 000

Aspiring geopark is characterized with 14 land use types aggregated in four groups: 1 - Discontinuous urban fabric, 2 - Agricultural lands (arable lands, pastures, complex cultivation patterns, lands principally occupied with agriculture with significant area of natural vegetation and natural grasslands); 3-Forested lands (coniferous, mixed or broad-leaved forests, transitional woodland-shrub); 4 - Unusable or unsuitable lands (bare rocks, sparsely vegetated areas in sharp ridges of cuestas or in high mountains).

Discontinuous urban fabric class is widely distributed across the territory except for high mountains.

Arable lands dominate in landscape of hilly eroded loess plains with chernozems, where they occupy 201.5 sq. km². The great share of arable lands is typical for the landscapes of remnant hilly plains (89 km²) and contemporary river valleys (48.8 km²).

Pastures prevail in cuestas (12.5 km²) and in submontane landscapes (6.7 km²).

Complex cultivation patterns have as a whole small areas and only in submontane landscape they occupy 2.8 km².

Lands principally occupied with agriculture with significant area of natural vegetation is a dominant land use type in submontane landscape on Triassic red bed rocks (4.6 km²), and on ordovik conglomerates and schists (19.9 km²).

Natural grasslands occur only in high mountains (7.4 km²).

The predominance of broad-leaved forests is marked in middle mountains (127 km²) and for the landscapes of low mountains and hilly uplands (55 km² in each of them).

Coniferous forests cover the majority of high mountains (6 km²).

Low mountains are mainly occupied with mixed forests (19.9 km²).

Transitional woodland and shrub are mostly typical for cuestas. In this landscape their area is 21.2 km².

Bare rocks have the most significant occurrence (2.2 km²) in submontane landscape on triassic red bed rocks.

Sparsely vegetated areas occupy 10.8 km² in cuestas and less than 1 km² in high mountains.

Tourist infrastructure

Tourist infrastructure map represent geospatial data on current tourist routes and different tourist attractions (Figure 3). Existing and supporting tourist routes in the territory of aspiring geopark are ecotracks and biking routes of several complexity levels.

Five just elaborated and supported ecotracks are named "Vedernik", "Zbegove", "Lepeniza", "The world of rocks" and "Planiniza". In regard to natural landscape diversity all the tracks are concentrated in submontane landscape on triassic red bed rocks with brown forest soils under oak and oak with oriental hornbeam forests. The most eastern track ("Planiniza") and the most western one ("Vedernik") also touch cuestas landscape.

Biking routes encompass the far greater territory, they haven't original names but can be classified according three levels of complexity into routes of low, medium and high complexity. Due to the significant length the each biking route meets several natural landscapes and thus the network of biking routes can support the acquaintance with the whole landscape diversity of the geopark. For example the route traversing the landscape of ridged plains on low carbon granitoids and argillites with brown forest soils under arable

lands and fallows along settlements of Dubravka, Rabisha and Stupiza in the west of geopark then near Rabisha settlement it meets the landscape of remnant hilly plains formed on neogen sandstones with dominantly tilled sod soils.

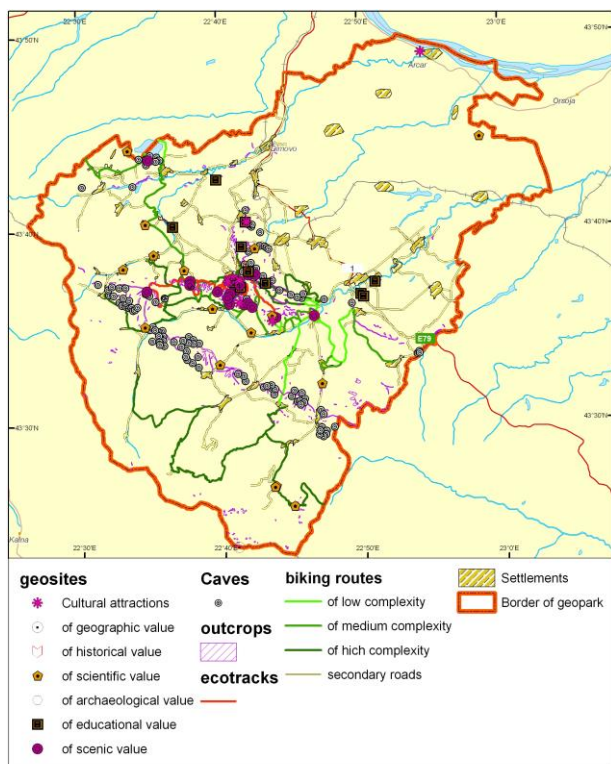


Fig. 3. Tourist attractions and routes. Initial scale 1:300 000

The landscapes of contemporary river valleys and submontane landscape on ordovik conglomerates and schists are touched by biking route near Protopeninzy settlement in south-eastern corner of geopark's territory. The segment of the biking route between Oreshetz and Vyrbovchez in the centre of geopark traverses landscape of hilly eroded loess plains.

Mountain landscapes are also well-represented in biking routes network: the landscape of middle mountains on carbon and permian diorites, granodiorites and gneisses under beech and coniferous-beech forests near Chuprene and landscape of middle mountains on carbon and permian diorites, granodiorites and gneisses under beech and coniferous-beech forests near Stakevtzy settlement. Only landscapes of high mountains aren't covered with any biking route.

Georeferenced tourist attractions include 75 geosites and 115 caves revealed us during detailed field survey of the geopark's territory. Revealed geosites are grouped according their objective value in several categories (Table 2).

Among revealed geosites 12 cultural attractions have a great interest not only for geotourism and scientific tourism but for sustainable tourism as a whole. All the cultural attractions are located near Belogradchik city and its closest neighborhood. Their list includes some museums, the observatory, churches and mosques. The most significant object is Roman castle "Kaleto".

Table 2. Number of geosites of different objective value

category according objective value	number of geosites
geographic value	1
scientific and archaeological value	1
historical value	3
mixed scientific and educational value	4
mixed scientific and scenic value	4
educational value	10
Cultural attractions	12
scientific value	17
scenic value	23
Total	75

Conclusion

The geopark can be considered as a specific protected area of multiobjective type and in thus it needs for complex and strong cartographic support under the process of its justification and further functioning. One of the key objective of the geopark is social and economic enhancement of the whole region where it is located. That's why necessity of clear representation of current land use structure and existing tourist resource in the territory of aspiring geopark Belogradchik rocks is conclusive.

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The article is reviewed by Prof. Dr. Jordan Kortenski and recommended for publication by "Geology and Geoinformatics" Department.