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GEOHERITAGE PROTECTION OF SERBIA – PRESENT SITUATION AND PERSPECTIVES

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Abstract: Neglected for decades in relation to the biodiversity and cultural heritage protection, the geoheritage protection has become a new concept, having more and more supporters in the world. The middle of the 1990s marked the beginning of the systematic geoheritage protection in Serbia. The basic components of that process are represented in the paper with the aim of evaluating the situation and noticing the key problems.

Key words: geoheritage, frames of protection, Serbia

Introduction

“Geoheritage includes all geological, geo-morphological, pedologic and special archaeological values originated throughout the formation of the lithosphere, its morphological formation and interdependence of nature and human cultures which have to be a special concern of all social factors as the part of unique geo-heritage of Europe i.e. world due to extreme scientific and cultural significance.”
(Declaration of the Conference “Geoheritage of Serbia”, 1995)

The lithosphere of Serbia, the whole Balkan Peninsula more precisely, is the youngest part of the present Europe. From the time of its formation up to the present days, it has been followed by various geodynamic and paleogeographical events (formation and then disappearance of the Pannonian basin, formation of inter mountain depressions, raising of mountain ranges, etc.), as well as “distinctive magmatism, volcanism, sedimentation and accumulation of various residues of life”, processes which enriched the lithosphere of Serbia by ore and energetic sources. Furthermore, the climate changes that occurred in the northern hemisphere (ice age and interglacial period), leaving vestiges in the nature of high mountains, indicated clearly the wealth of geodiversity represented by many different types of geoheritage sites (Pantić, Belij, Mijović, 1998). The geoheritage sites-different profiles, relief forms, artificial excavations of rocks during mining and other engineering works are crucial for understanding the Earth’s geoheritage.

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Studying them, science has made some discoveries significant for the past, present but also future processes and phenomena i.e. it uses them to anticipate better some changes, perhaps some potential, natural hazards, too. Moreover, these “natural laboratories” and “museums in the open” serve for education of the young generations. Representing special polygons for training and education, they enable the demonstration of geological principles and illustration of the processes of relief evolution, while spreading the conscience on the necessity of the protection of the whole nature, they also have the role of educating population starting from the youngest one. Above all mentioned, these phenomena, processes and localities also contribute to the aesthetics of the regions.

The main criterion for selecting the geoheritage sites has not been the only one - whether on the basis of the same we can come to the information significant for identification and understanding the processes that occurred in the past. In dependence on the observer (an expert or amateur), often used criteria are rarity, i.e. uniqueness of the phenomenon, representativeness, complexity and others. There is a series of different valuable criteria, as well as large number of classifications which differ from country to country. The classifications serve for easier selection and protection of the geoheritage sites. The use of only one mutual concept for the geoheritage assessment started in the 1990s on the initiative of IUGS, UNESCO and IGCP (Mijović, Rundić, Milovanović, 2005), with the aim of standardizing, systematizing the geoheritage sites, as well as making the inventory in different countries. The Wimbledon classification was adopted in 1996 (Table 1) within the ProGEO organisation.

Table 1. Classification of geoheritage sites

A	Palaeobiological – macro and micro fauna, flora, vestiges, biochemical, stromatolite
B	Geomorphological –regions, caves, volcanoes, waterfalls, fjords, cirques, karst...
C	Palaeoecological – former climates, global sediment geology, fossil indicators
D	Magmatic, metamorphic and sediment petrological, textured and structural
E	Stratigraphical – events, sequences, stratotypes of upper boundaries, interval of stratotypes, biozones of type of sites of broader meaning, palaeomagnetic events...
F	Mineralogical
G	Structural – main tectonic or gravitational structures
H	Economic– of all types, intrusive, discharges, metallic and nonmetallic deposits, mines and quarries
I	Others – historical, for development of geological science

Source: Wimbledon (1996)

According to different classifications of geological heritage used in European countries, D. Mijović (2002) singled out several mutual categories of geoheritage sites. These are: geological sites with scientific contents; geological sites with educative significance; geological sites with unique contents on the level of observation; geological sites with aesthetical values; and geological park. Mijović D. and Miljanović D. (1999) emphasized that it was of the greatest significance to make the difference between the sites of the first category (scientific significance) and the second one (educational significance), since the criteria of evaluation, as well as the very conception of the protection of geoheritage sites was depending on it (Table 2).

Table 2. Criteria for evaluation of scientific and educational values of geoheritage sites

Scientific criteria	Educational criteria
Site described as stratotype	Scientific significance
First discovery	Possibility of correlation
Site described as <i>locus typicus</i> (flora, fauna – fossil)	Access to phenomenon
Site described as topotype or holotype (possibility of correlation)	
Site of specific sediment structure	
Site of specific tectonic structure	
Significant geomorphological site	
Remains of former mining	
Significance of pedological profile	
Site of special archaeological values	

Source: Mijović, Miljanović (1999)

The concept of the protection of geodiversity has been the newness in most countries. The nature conservation movement which was roused throughout the world at the beginning of the 19th century was primarily focused upon extraordinary regions full of geological attractions like Yellowstone (the first national park in the world in 1872) and Yosemite (protected area in 1864), while less on wildlife. The famous German naturalist, geographer and explorer Alexander von Humboldt (the second half of the 18th and the first half of the 19th century) was the first one who pointed to the necessity and significance of the protection of “natural monuments” as he called them, i.e. natural rarities for the scientific purposes. Marking the extraordinary phenomena as “curiosities” within the geosites, the most eminent names of our natural sciences dealt with them in the 19th century J. Žujović, J. Cvijić, V. Petković et al. (Đurović, Mijović, 2006).

The term “geological and geomorphological conservation” was common among the professional public up to 2000, while later the term geoconservation was accepted. When saying conservation, it is not only meant on protection, but also

adequate managing and using the natural resources. There is also a wider term “geodiversity conservation” or “conservation of the Earth’s heritage” which includes not only the conservation of rocks, fossils, minerals, relief forms, but also the items in museums, structures, archives, maps and relevant data (www.geoconservation.com).

The systematic work on the protection of geoheritage in Serbia started in the middle of the 1990s by accessing the European Association for the Conservation of the Geological Heritage (ProGEO) and founding the National Council for the Geoheritage. The frameworks of the geoheritage protection, their functioning and current situation of the protection in Serbia are the basic subject research of the paper.

Geoheritage Protection

The lithosphere of Serbia, as the part of the Balkan Peninsula and the youngest part of the present Europe, keeps data on the climate, geodynamic, palaeogeographical and all other events from all epochs of the previous geological history (Pantić et al., 1998). That very fact is sufficient reason for the geoheritage protection. In the scientific-educational domain, those are also the specialist’s education, education of young generations through the cognition and representation of this natural resource, while the economic significance is also important (resource, communal and tourist as the form of activity by which the cognition will be enabled, as well as protection, since the financial resources can be provided).

According to Dangić (1998), there are four phases in the process of the geoheritage protection:

- Identification - certain criteria should be ascertained firstly (representativeness, uniqueness of the phenomenon i.e. rarity, complexity, aesthetical experience, etc.). The selection of the criteria is the major and difficult task. The compatibility of the classifications depends on it. An inventory of the geoheritage sites has been carried out within the National Council for the Geoheritage of Serbia, as well as according to the Wimbledon classification. Owing to this project, around six hundred and fifty geoheritage sites have been selected in Serbia until today;
- Valorisation, i.e. establishing the significance of the sites within the ones similar to them. Within the national programmes of the valorisation, the categorisation of the sites has mainly been done according to the significance they have in the world, i.e. Europe, region, state or part of the state;

- Conservation/protection of the sites which can be in situ (in the original place) or ex situ (in the collection of some museum, institute, faculty, etc.). The natural and anthropogenic factors which influence negatively the natural heritage are various, and in dependence on the degree of endangerment, they are applied either as 1) only physical protection or 2) the combination of physical protection and conservation (2a-protection from adverse effect of natural geological-chemical factors; 2b-protection from adverse effect of anthropogenic-geochemical factors);
- Presentation in order to acquaint the public with all sites, it is necessary to represent them adequately. Dangić mentioned two basic ways of the presentation: 1) physical presentation (a-in situ, b-ex situ) and 2) presentation in publications and media (a-scientific: collection of papers, monographs, journals; b-popular: textbooks, media, etc.).

The necessary components of integral process of geoheritage protection are the following: legal, planned, institutional and educational.

Legislative Frame of Geoheritage Protection

Law on Nature Protection (2009) will advance the solving of issues of protection in general, as well as geodiversity i.e. geoheritage as its representative. It, among others, regulates the newness in regard of types and categories of protected natural resources. According to Law on Environment Protection from 1991 - Official Register of the Republic of Serbia No. 66/91 and Law on Environment Protection from 2004 - Official Register of the Republic of Serbia No. 135/04, six types of natural resources are selected: national park, nature park, region of extraordinary characteristics, nature reserve (general and special), natural monument and natural rarities. The Law was of special significance because the problem of protection was put on the level of systematic law for the first time, immediately behind the Constitution. Now, the following will be distinguished within protected natural resources:

- Protected areas and within them - strict nature reserve, special nature reserve, national park, natural monument, protected habitat, region of extraordinary characteristics, nature park;
- Protected species - strictly protected wild species, protected wild species;
- Protected movable natural documents (parts of geological and palaeontological heritage, as well as biological documents of extraordinary significance).

Introducing the category of protected movable natural documents will contribute for the first time to the concrete protection of the geoheritage sites because the Law regulates the conditions of their conservation, use, but it also brings the prohibitions and sanctions.

The geoheritage sites are most often protected in the legal category of natural monument. However, in dependence on dimensions and characteristics, they can also be protected in all other larger categories (Mijović, Miljanović, 1999).

All protected natural resources are entered in the register which is kept as central, provincial and register of protected movable natural documents. The Institute for Nature Conservation of Serbia is responsible for the central register; the Provincial Institute for Nature Conservation is responsible for the provincial register, while the Museum of Natural History is responsible for the register of protected natural documents.

Planned Frame of Geoheritage Protection

A planned frame of the protection of space is based on different kinds of plans - spatial, sector (agriculture, forestry, waterpower engineering, energetic sources, etc.), as well as the instruments for directing the development. The planned base of the protection of space in Serbia includes spatial-planned base, sector planned base and technical documentation. The spatial-planned base is realised on three levels of planning: national (Spatial Plan of the Republic of Serbia), regional (regional plans and spatial plans of the regions for special purposes) and local (urban plans). The most significant plans from the viewpoint of the protection of natural values, as well as the protection and reservation of space in general are the spatial plans of the regions for special purposes. They often belong to the regional level and ascertain the zones of different degrees of the protection, regimes of use and spatial organisation within the protected areas (Maksin-Mičić, 2000).

Spatial planners justify an adequate spatial-functional organisation, with the assistance of experts for nature conservation, which includes the zones of protection (Mijović, Miljanović, 1999). According to Law on Nature Protection (Official Register of the Republic of Serbia, no.36/09), there are four zones of the degree of protection, i.e. the following regimes of the protection:

- Ia degree - strict protection;
- Ib degree - strict protection with the possibility of managing the populations;

- II degree - active protection;
- III degree - active protection and the possibility of sustainable use.

Planning the nature conservation has been the integral part of the overall socio-economic and spatial planning, but at the same time specific and considerably autonomous (Lješević, Nikolić, 1991). The Spatial Plan of the Republic of Serbia is the systematic law and main strategic planned document of managing the space on which the planned nature conservation of Serbia is based. Since it offers guides and recommendations of the future protection as the strategic document (planned period up to 2010), it has not dealt with geoheritage protection directly but through the prism of overall nature protection, recommending for example the increase in the per cent of areas under protection (from the former 4.97% to the planned 10% of the state territory), the making of spatial plans of the areas for special purposes for protected areas with concrete regimes of protection, the prohibition or controlled use of resources, space and activities, the making of analyses of influence, but as such it provided the base for some concrete actions on the future nature protection, as well as geoheritage sites as one of its segments. In 2009, the Strategy of the Spatial Development of Serbia was adopted for the period up to 2020 with the strategic priorities up to 2013, representing the basis for the making of the future Spatial Plan of the Republic of Serbia. The geoheritage was not mentioned at all, but the care about this segment of nature could be seen through the defining of strategic priorities within the protection of the environment, regions, as well as cultural heritage (The Strategy of the Spatial Development of Serbia, 2009).

The draft of the Spatial Plan of the Republic of Serbia deals more concretely with the problem of geoheritage protection, not mentioning the concrete term geoheritage, but the terms as “valuable natural heritage” and “various and attractive regions“. In chapter D.12 - Biodiversity, Protection and Sustainable Use of Natural, Cultural Heritage and Regions, it is emphasized that together with biodiversity and cultural heritage they represented “significant resource for the future spatial development of the Republic of Serbia.” Apart from the principles of the sustainable use and decrees of international conventions and strategies, the Plan anticipates the making of national strategies, as well as a series of new laws, which, together with the formation of the National Ecological Net and identification of areas for the European ecological net NATURA 2000, will contribute to the aim of planned increase of 12% of the territory of the Republic in the total area under the protection of natural heritage (Draft of the Spatial Plan of the Republic of Serbia, 2010).

Institutional Frame of Geoheritage Protection

Experts from the field of geosciences (geologists, geomorphologists, geographers) rarely dealt with the protection of regions and sites in nature. The experts from various biological profiles have always overridden (Belij, 2007). That is probably one of the reasons for the “popularity” of biodiversity and significant increase of conscience on the necessity of its protection. The movement for geodiversity protection has become more active in the world. Geo-diversity was so much neglected that Sharples (Sharples, 2002) headed his book, in which he wrote about geoconservation in Tasmania, “Forgotten Half of Nature Protection”.

The key year for arousal of conscience on the necessity of geodiversity protection was 1995. Serbia became the member of the European Association for Conservation of the Geological Heritage - ProGEO, when the work group for south-eastern Europe ProGEO-WG1 was formed in Sofia. In the same year, the National Council for the Geoheritage of Serbia was founded in Novi Sad, when the first conference on the geoheritage of Serbia was held (the second conference was held in June 2004). ProGEO is one of many organisations which deal with the issue of geoheritage. It was founded in 1988 in Sictuna, Sweden, and at the beginning of its work it was oriented exclusively to Western Europe. The basic aims of this organisation were to promote conservation of the wealthy European geoheritage, characterised in landscapes, rocks, fossils and mineral deposits; inform the broader public on the significance of their protection; give guides to institutions responsible for the protection of local, regional and European geoheritage; organise scientific, planning and managing researches; activate all European countries to exchange ideas, information and experiences in the protection; form the unique list of geoheritage and thus help the local organisations in the geoheritage protection; give the unique approach to the nature protection, using holistic approach in the protection of biological and physical phenomena. Moreover, ProGEO promotes the programme called GEOSITES (A Global Comparative Site Inventory), initiated in 1996 by the International Union of Geological Sciences (IUGS) with the aim of making balance between biological and geological conservation, through the identification of geological areas of the international significance and the making of inventory and database.

The expert institutions for geoheritage protection in Serbia are the Institute for Nature Conservation of Serbia and the Natural Museum of History. The Institute for Nature Conservation was founded in 1948 as the Institute for Conservation and Scientific Study of Natural Rarities of the National Republic of Serbia. It worked

on advancement and promotion of nature and its protection, as well as geoheritage as one of its segments. Owing to the Institute, 40 geosites were protected in the period from 1948 to 1975 (Nojković, Mijović, 1998), while nowadays the number has increased to 80 separate sites and many geoheritage sites are under the protection of some larger natural resources. The research work, professional supervision of natural resources and cooperation with managers and museum - natural activity, are some of activities that the researchers of the Institute deal with. Professional education is also given much importance. In the 1970s, the Institute began working on the permanent training of teachers and professors, organising specialized courses from the field of the nature and environment protection. Also, experts of the Institute gave their contribution by educating the population of naturally valuable and attractive regions about the significance of preservation (Simonov, 1998). The Institute is the organiser of various conferences, seminars, summer schools and camps. Its publishing activity is also developed (scientific journal "Nature Protection", monographs, maps, CDs and DVDs, etc.). Except mentioned activities that the Institute deals with, the initiating of the procedure of protection is probably the most significant activity. Experts from the Institute make the studies of protection in which, on the basis of gathered data in the terrain, they make the valorisation of the natural site suggested for the protection, establish the borders and suggest measures and regimes of the protection, as well as the very category of the protection. When the proposal for protection is submitted to the authority, the procedure of the protection is considered to be initiated. The authority is obliged to organise the public inspection and discussion about which it informs the public through at least one daily paper distributed in the territory of the whole Republic of Serbia, as well as through local paper of the unit territory on which the site is situated. The Government designates the areas of extreme, i.e. Republic significance as protected on the proposal of the Ministry that is responsible for the activities of the environment protection, while the local autonomy units designate other areas as protected in the territory of which the resources are located. The National Assembly passes a special law by which the national park is designated (Law on Nature Protection - Official Register of the Republic of Serbia, no. 36/09). The geoheritage sites are most often protected in the category of natural monument, but in dependence on the dimensions and characteristics they can be protected in all other larger categories (Mijović, Miljanović, 1999). The Natural Museum of History was founded in Belgrade in 1895 as the Jestastvenički Museum of Serbia. The geoheritage sites are protected ex situ in the museum, in wealthy collections with several hundred of holotypes and unique mineralogical and petrological samples of extraordinary scientific

significance originated from the regions of Serbia and former Yugoslavia (www.nhmbeo.rs). The Museum carries out the whole process of geoheritage protection through gathering, studying, storing and presenting the sites. Except in the Natural Museum of History, the geological collections are also kept in the Faculty of Mining and Geology, the Institute of Geology of Serbia, as well as in the company “Nis - Naftagas”.

Geographical Information System (GIS)

If one of the basic principles of GIS is applied, which is the accuracy of information, as well as the standardisation of its use is carried out in the local, national and international frames, the geographical information system becomes one of the irreplaceable tools for the contemporary management and geoheritage protection of the country (Jovanović *et al.*, 1996). Some of the ways of using GIS in the process of geoheritage protection are the creation of data bases on geoheritage sites and their use for the purpose of spatial analyses. Besides using GIS for the scientific data base, one of its practical implementations in the process of geoheritage protection has been the use for the purposes of mapping geoheritage sites and making maps and diagrams. The last one in a series of workshops organised by the International Association of Geomorphologists (IAG), the work group Geomorphosites, was held in Lausanne in June 2008, having the mapping of geoheritage as the theme with the aim of developing the unique methodology along with the application of GIS and new information and communication techniques.

In 2003, on the initiative of B. Vasiljević and with the engagement of D. Štrbac and collaborators, the Institute for Nature Conservation of Serbia started the pilot-project of the Information System on the Protected Natural Resources, realized in GIS (Geo Media/INTERGRAPH). The Institute is responsible for the Register of Protected Natural Resources consisting of the main book (it includes registered papers, 12 columns with basic data on the resources) and collections of documents, while the Standard Register Scale regulates the obligation of conversing them in electronic form. The map of Serbia at scale of 1:1 000 000 is taken as the backing on which all natural resources that have been protected until then are located. Moreover, the data base was made (ACCESS base) in which alphanumeric and other data are entered for all resources. Nevertheless, the resources are grouped according to thematic wholes such as: natural regions, nature reserves, natural monuments - dendrological - botanical, natural monuments - geoheritage sites and cultural-historical regions. The areas less than 1 000 ha are represented by dots,

while larger ones by areals. The programme is useful primarily from the aspect of fast data obtaining on the resources by simple clicking the sign on the map with the possibility of asking questions and the representation of resources with all attributes in the map or table (Štrbac, 2004). The main point of the project, the use of which has never been realized, was education, as well as to acquaint the employed with the information system and converse all data on resources in digital form in order to be available for all and protected from decay. What is positive is that all errors can be noticed during data conversion into information system, as well as scanning and digitalisation. They have to be corrected and it must be defined which data are true, because data in the information system are declared to be the official ones. Nevertheless, the Institute got the information system on the protected natural resources several years later, which is just a segment of the business information system of the Institute, intended exclusively for internal use.

Education

Family rouses children's conscience on the connection between man and nature and the necessity of nature protection. This can be achieved in their earliest ages by prohibitions like "do not walk on the grass", "do not pick leaves", while various trips are also significant for children's acquaintance with nature and processes in it. Owing to subjects World around Us, Knowledge of Nature and Society in lower grades of elementary schools, as well as Biology, Geography, Physics and Chemistry in higher classes, school children are given better knowledge about the world which surrounds them. School children are also involved in various outdoor teaching activities such as the membership in the nature conservation club, scouts, mountaineers, which often influence the children's later choices and determinations (Đurđić, 2001). In 1998, the European Commission SOCRATES/COMENIUS initiated the project called GRECEL with the aim of acquainting professors in high schools with geological sciences and geoheritage. Serbia did not participate in this project (Mijović, 2005).

Education does not only refer to educational institutions. Very important is the constant education of people employed in management of protected natural resources who influence directly the preservation and conservation of these regions. Parallel with the involvement of educated and trained volunteers, the visitors should also be educated, not only by talk, but corresponding propaganda-distribution of published material, putting up posters and placing billboards and notice boards (Đurđić, 2001). Experts in different geopfiles have also been educated. The first seminar, intended for associates of the Institute for Nature Conservation of Serbia,

was held on Mountain Tara in 2004 under the title “Seminar on Geodiversity and Geoheritage in Nature Protection”. It was also the first training course on the geoheritage in Serbia (Mijović, 2005). The last activity in a series of similar ones is Geotrip 2007 which was oriented to loess and gathered domestic experts from different geo-disciplines.

Media and Public Relations

The beginning of 1990s marked the decrease in the number of television broadcasts and newspaper articles devoted to ecological problem in general. There is current information, but it is mainly passed through the columns about health, economy or politics (Iljenko, 1998). Đavolja Varoš is obvious example of the significance and influence of the media. The interest for this geosite suddenly increased in 2009. The motive was the internet voting on the global level for seven natural wonders of the world. As soon as it leaked out that our candidate was highly ranked, the media started giving daily information, and even the trustee of this natural site, which was protected in 1959, announced an open competition for the ideological solution to souvenir. This action initiated the selection of seven wonders of Serbia, which was justified in such a way that readers sent suggestions and explanations, which resulted in special issue “Seven Wonders of Serbia”, popularizing thus natural attractions and rousing people’s consciousness about the necessity of the protection.

Conclusion

There are many factors which endanger geoheritage sites, influencing negatively the geodiversity. Except the main threats to the preservation of geodiversity wealth (erosion, waste disposal, exploitation of mineral sources and stones, agriculture, urbanisation, other changes in the land use, exaggerated spreading of vegetation, tourist and recreation pressures, collections, climate changes and changes of the sea level), some situations also represent obstacles to the protection and conservation of geoheritage, e.g. when the property in which the locality is situated has several owners, as well as when the locality, i.e. site is insufficiently explored. Therefore it is important to deal with all segments of the protection - legislative, planned, institutional and educational.

The first and basic step towards the overall protection of the geoheritage of Serbia is the making of the inventory of sites, having in mind that it is not the same as the cadastre of their widespread. Moreover, it is necessary to solve the problems of legislation. Large problem is to preserve the valuable areas and sites when the

obligation of their entering into deed books does not exist. Such areas have rarely been the state property, so it usually comes to the conflict of interests and disregard of issued limitations of use (Vider, Stević, 2009). All mentioned has been the part of the necessary concept of active managing. In contrast to the previous passive form of the protection (identification, assessment, administrative protection), the active managing means the making and realization of the managing programme, the monitoring, skilled and educated managers, the coordination between different spheres of interest (geomangement), following the world trends in the field of the geoheritage protection (the foundation of geoparks as the part of the concept of the sustainable (geotourism), as well as adequate promotion and presentation.

The precondition of all is the financial support which is mainly missing in Serbia. But this has also been contributed by managers who do not treat the natural resources as the potential resource which will provide means necessary for its own maintenance and advancement (Puzović, 2009).

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