

VALUING THE GEOLOGICAL HERITAGE OF SERBIA

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Geological sites and objects display various rock formations, structures, landforms and fossils that make a special contribution to the understanding and appreciation of the geological history of Serbia. Knowing and assessing the whole geodiversity of Serbia through study of individual phenomena is the starting point for their rational utilization and conservation. Considering the fact that criteria for geodiversity valuation are neither agreed upon nor acknowledged by regulations, basic principles for judging the significance of geodiversity are discussed and the main categories are proposed.

Key words: Geoheritage, Serbia, procedures for evaluation, categories of non-movable and movable geoheritage.

INTRODUCTION

“You cannot understand conservation without first having an appreciation of the value of the item to be conserved” (Cynthia Burek)

Geodiversity is defined as the variety within the entire abiotic world, which encompasses the natural range (diversity) of geological (bedrock),

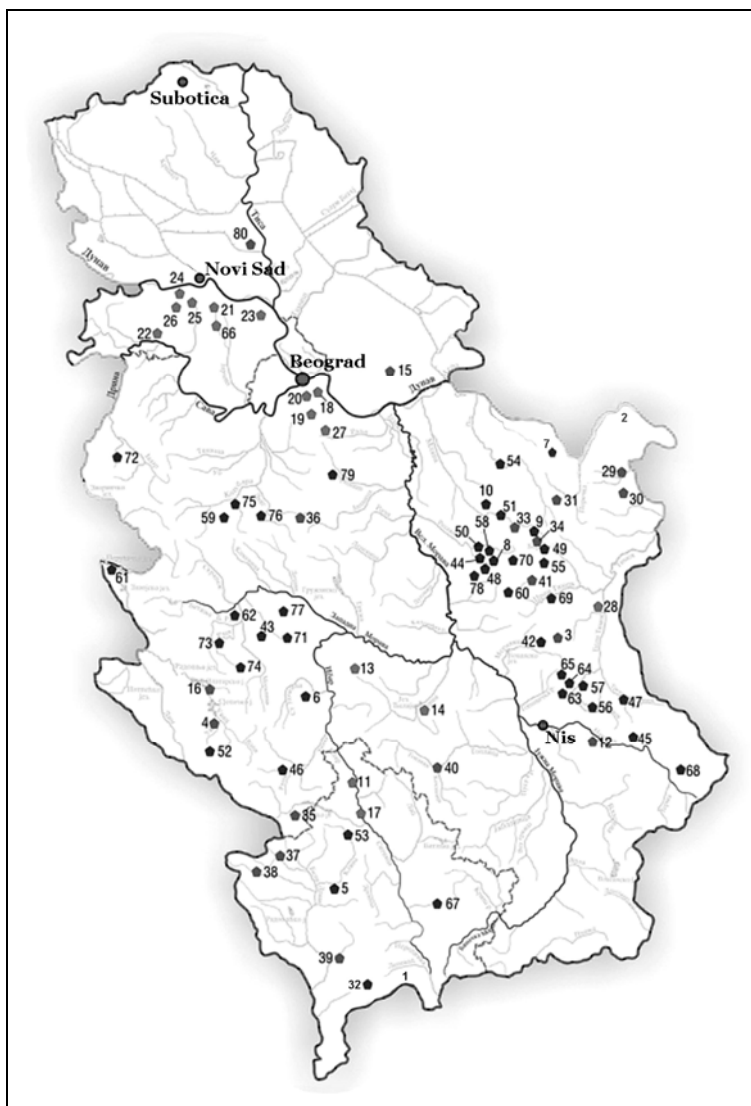


Fig. 1. - Map of protected natural monuments related to geoheritage till 1990 (source: Institute for nature protection of Serbia, modified).

National park: 1. Šara Mt. 2. Djerdap/Iron Gate; **Natural park:** 3. Lepterijski / Sokograd 4. Mileševka River Gorge 5. Miruša River Gorge; **Nature reserve:** 6. Dajičko Lake 7. Boljetin River Gorge 8. Resava River Gorge 9. Suvaja River Gorge 10. Osanica River Gorge 11. Limestone reef “Kamilja” 12. Jelasnica River Gorge; **Special Nature reserve:** 13. “Lojanik” petrified forest 14. Fossiliferous site “Prebreza” 15. Deliblatska Pampa; **Natural monuments - geological:** 17. “Stari trg” mineralogical museum 18. Miocene reef “Tašmajdan”/Belgrade 19. Senonian reef “Mašin majdan”/Belgrade 20. Neogene reef “Kalemegdan”/Belgrade 21. Rakovac fossiliferous site with Pliocene

fauna 22. Skull of *Megaceras* (paleontological collection, Sremska Mitrovica) 23. Loess profile, Stari Slankamen 24. "Beočinska plaža" 25. Čot loess profile 26. Upper Cretaceous site, Čerević/Fruska Gora 27. Karagača fossiliferous site 28. "Baranica" fossiliferous site with Pleistocene mammal fauna; **Natural monuments - geomorphological**: 29. Vratna River Gorge with two stone-bridges 30. Zamna stone-bridge 31. Valja stone-bridge 32. "Prizrenska Bistrica" 33. "Bušan kamen" 34. Samar stone-bridge 35. Pećine stone-bridge 36. Ostrovica panorama 37. Beli Drim springs with cave and Radavac waterfalls 38. Rugovska Gorge 39. Beli Drim River Gorge/Švanjski most 40. Đavolja varoš (Devil town) 41. Lazareva Gorge 80. Titelski breg; **Natural monuments - hydro(geo)logical**: 42. Great and Small Ripaljka, waterfall and caves 43. Potajnica karst spring/Arilje 44. Waterfall Lisine 45. Krupac Spring (Blue eye) 46. Promuklica/Tutin 47. Waterfall Bigreni potok/Stanjinac 48. Great Spring / Strmosten 49. Mlava Spring 50. Homolje intermittent spring/Laznica 51. Krupaja Spring 52. Sopotnica Waterfalls 53. Mineral spring, Vuča village; **Natural monuments - speleological**: 54. Gaura Mare Great Cave 55. Lazareva Cave 56. Prekonozi Cave 57. Ravna Cave with Propast swallow hole 58. Radoševa Cave 59. Petnica Cave 60. Ravanica Cave 61. Topla peć Cave 62. Potpeć Cave 63. Cerjan Cave 64. Samar Cave 65. Popšić Cave 66. Popov Čot Cave 67. Mermerna (Marble) Cave/Donje Gadimlje 68. Petrlaška Cave 69. Bogovina Cave 70. Vrtačelja shaft 71. Hadži-Prodanova Cave 72. Kovačević Cave/Cerova 73. Bukovik Cave 74. Stopić Cave 75. Ribnica-Paštrić Cave 76. Mala bezdan (Small hole) Cave 77. Réan Caves 78. Resava Cave and 79. Risovačka Cave.

geomorphological (landform) and soil features, assemblages, systems and processes (Dixon 1995, Sharples 1995, Eberhald 1997). Moreover, geodiversity includes evidence of the history of the earth - the evidence of past life, ecosystems and environments and the range of biological, hydrological and atmospheric processes, currently acting on rocks, landforms and soils. The term geodiversity has been used to describe the nature of the diverse heritage we are seeking to protect and enhance through this work (Maran 2010).

Geoheritage entails concrete examples of geodiversity, which may be specifically identified as having conservation significance. Geoconservation can be explained as action taken with the intent of conserving and enhancing geological and geomorphological features, processes, sites and specimens. Geoconservation is briefly defined by Sharples (2002) as "the attempt of trying to conserve geodiversity and geoheritage for their intrinsic, ecological and heritage values". As successful conservation often depends on understanding and valuing features to be conserved, the actions usually taken also include promotional and awareness raising activities.

Although nature conservation has a relatively long history in Serbia, little concern has been given to geoconservation. Before the 1990s, only 80 geological sites were registered and 'put' under protection (Fig. 1). Among

them, sixteen localities were declared as particular natural monuments and their preservation was organized inside protected areas (e.g. national parks, natural parks or nature reserves). Sixty four other sites were assigned as single monuments or landscapes with special characteristics, and classified into 4 groups: geological (12), geomorphological (14), hydrogeological (12) and speleological (26). They were selected for protection in reference to documented individual or institutional proposals previously given and approved by the Institute for the protection of nature in Serbia. All assert geological entities belong to non-movable heritage except a single ex situ/movable object (the skull of *Megaceras* from Paleontological collection, Sremska Mitrovica). Even though these geosites were proclaimed “protected”, nothing was done for their accurate conservation.

Following the First Conference of Geoheritage of Serbia (1995), the Yugoslav National Council for Geoheritage conservation was established. The Council initiated a voluntary project in 1996 having as its main aim the registration of geoheritage sites of Serbia, based on the recommendation of the ProGEO (Maran 2008). As a result of Project-related activities, over 650 geosites have been designated for further protection. In recent years, various projects and activities have worked to promote and implement geodiversity and geoheritage conservation. In the legislative domain, the most significant outcome is the introduction of the terms **geodiversity and geoheritage** (the Law on environmental protection 2009).

PRINCIPLES FOR SELECTION

Procedures for assessing geodiversity depend on the valuing criteria. In the UK, as the country with the best-developed system of site-assessment, different criteria have been applied to serve different purposes such as those used in the Geological Conservation Review and designation of the Regionally Important Geological/geomorphological Sites (Burek 2005, Burek & Potter 2004, Prosser 2002a, 2002b, 2005, Stanley 2007). In other countries, different methods have been developed for specific situations (Alcala & Morales 1994, Joyce 1994, Wimbledon 1998, Wimbledon *et al.* 1998, Gray 2004, White & Mitchell 2006, Scott *et al.* 2008, Pena dos Reis & Henriques 2009).

Three key values are defined by Sharples (1993, 1995, 2002) as intrinsic (“*it is of value because it exists*”), ecological (or natural process value) and anthropocentric (human-centered value or geoheritage). The concept of intrinsic value means that the earth possesses, and phenomena may have, value beyond the social, economic or cultural values held by

humans. The ecological value of geodiversity can be understood as its importance in both maintaining geological, geomorphological and soil processes, and in maintaining the biological processes which depend upon those physical systems. The anthropocentric values represent the direct value of geological, geomorphological and soil systems to humans. These include scientific, research and educational sites that inspire people due to their aesthetic qualities or which are significant in the role they play in cultural or spiritual values of particular communities. The economic value of geodiversity is also a part of them; minerals, rocks, and even fossils all have economic (or financial) value that varies depending on the nature of the material (Sharples 2002). The choice of criteria for judging the significance of geodiversity for conservation is considered the first stage in any assessment by subdividing the three key values into scientific-research-educational, social-historical and aesthetic (Maran 2005). This is followed by evaluating their importance (levels of significance).

The best method for site selection is to establish systematic national inventories of geological sites. Proposals for site selection have to be scientific-based and explained in detail. Selected objects must be of major significance, well-preserved, and the most representative in their group of phenomena. In practical terms, site assessment entails various operational criteria such as: a) the site can be conserved in a practical sense; b) the replication of interest among sites is minimal; c) the site is less vulnerable to potential threat; d) the site shows an extended or quite complete record of the feature of interest; e) the site has a long history of research study; f) the site has potential for further investigation; g) the site is assessable and h) it has played an important part in the development of the earth sciences (Gray 2004, Maran 2008).

But, before selecting a single site or object, we have to identify what is the unique, special or typical feature of a site/object and which one is the best representative of particular geological phenomena. Although criteria for geoheritage valuation are not nationally agreed upon nor acknowledged by regulations, some starting principles have been adopted by skilled experts in the field of geosite assessment and put into practice. Accordingly, criteria for judging the significance of geodiversity are discussed, hoping for their formal acceptance for geodiversity assessment by relevant authorities.

How representative the feature is: The site must be representative geologically or geomorphologically. To meet this first criterion, a geosite has to signify the most complete and expressive manifestation of a specific phenomenon and should allow the most comprehensive understanding of the nature and origins of the phenomenon (Wimbledon 1998). A geosite

should demonstrate significant events and episodes of earth history, including the record of life, important on-going geological processes in the development of landforms, or important geomorphologic features.

How rare the feature is: Geological resources are finite and most of them are non-renewable or renewable only over very long timescales (Gray 2004). Although two sites or objects can share similar characteristics, each geological site/object is unique (non-repeatable). The second principle, associated with the first, is the uniqueness or special aspect of a site. This attribute depends on different qualitative and quantitative parameters. Qualitative indicators can include complete stratigraphic succession, special combination of fossils, unusual paragenesis and mixture of minerals, magnetic anomalies, huge tectonic structures (folds and faults), as well as special geomorphological and soil processes. The age range is also considered a qualitative indicator (e.g., first or last appearances of particular floral and faunal assemblage, distribution of taxa, transgressive or regressive events, etc.). Quantitative parameters entail some physical characteristics of a site like size, thickness, depth, height or frequency (e.g., concentration of minerals, concentration of microfossils, metals in ores, rates of modification-erosion and deposition).

How the site compares with other similar sites: The third criterion is the appropriateness (suitability) of the geosite for correlation. The most valuable geosites are those that enable international correlation.

How complex the site is: The fourth principle refers to the diversity (complexity) of a site. For instance, a particular cave can be at the same time a karstic feature, and a paleontological-archeological site. As a result of the joint impact by endogenic and exogenic geological processes, most sites are complex in their nature.

How vulnerable the site is: Geosites vary considerably in their physical attributes and their vulnerability to damage or change. Geological sites can be classified according to their sensitivity which depends on the size of the site and the erosional processes acting on it. Very limited or finite resources are the most fragile sites, which are irreplaceable if destroyed (e.g. cave deposits).

How significant the site is: The geological significance of sites should be classified at international, national, regional and local levels, by documentation, assessment and comparison. Site information must be reviewed on the basis of personal experience, fieldwork, literature and consultation with other geologists with specific knowledge and expertise. The significance rating assigned to a site must be periodically reassessed in light of new information and site condition.

NON-MOVABLE (*IN SITU*) GEOHERITAGE

Non-movable geoheritage refers to geological sites such as natural rock exposures, active, abandoned and historic quarries, and other man-made excavations. In detail, the components that should be recognized within geoheritage include:

1. Igneous, metamorphic and sedimentary rocks and their processes of formation,
2. Mineral resources (minerals and mineralization), mines and quarries,
3. Structural and tectonic features on all scales,
4. Fossils,
5. Stratigraphical contacts,
6. Fossil and present landscapes and active processes (e.g. slopes, rockfalls, landslides, rivers, estuaries, beaches),
7. Hydrogeological features,
8. Weathered rocks and soils and soil-forming processes,
9. Building stones and related products.

Based on discussed criteria and guidelines and adopted from the Law on cultural properties¹, three groups are proposed for categorization of non-movable geoheritage: 1) Internationally Important Geosites (IIG); 2) Nationally Important Geosites (NIG); 3) Regionally Important Geosites (RIG).

Internationally important geosites (IIG)

These sites should include outstanding geological and geomorphological phenomena that are unique (rare) in the world by the nature of their scale and state of preservation, and are comparable with examples known internationally. They belong to the category 'global type representatives', widely known by the geological community worldwide as reference sites that have to be registered in an international inventory of sites of outstanding significance. In a stratigraphical and paleontological context, this category should entail: chronostratigraphic stratotypes, biozonal type localities, sites that contain particularly diverse assemblages of fossils or specimens with unusual taphonomic characteristics, sites that have high

¹ In Serbia, two large categories of the national cultural and natural heritage are recognized by the Law on cultural properties (No. 71/1994) - non-movable (*in situ*) and movable (*ex situ*) heritage.

species diversity and well preserved fossil representatives (high quality preservation) as well as complex sites (sites that are at the same time of paleontological and archeological interest).

At this stage of investigation, the intention is only to propose localities that could be assigned as outstandingly significant. Their authorization will remain the final decision of an expert team (e.g., the Serbian National Council for Geoheritage conservation). Among numerous valuable geological phenomena in Serbia, this rating is proposed for the following geosites: 1) Lazareva and Vernjikica caves (Zlot Gorge, eastern Serbia) (Fig. 2) as they represent the first natural areas in Serbia, proposed for conservation by P. Pavlović (1924); 2) Geosites along the Boljetin River valley (Djerdap



Fig. 2. - First proposed natural area in Serbia for conservation - Zlot Gorge with Lazareva Cave (geosite no. 55) and Vernjikica Cave, eastern Serbia.

Gorge, eastern Serbia) that represent the Jurassic-Lower Cretaceous succession with well preserved ammonites in the red nodular limestones (the Middle Jurassic / Klaus facies, (Rabrenović & Maran 2005)); 3) Velika, mala and suva prerast / Big, small and dry stone bridges on Vratna (near Negotin, eastern Serbia), as the best developed and preserved karstic-geomorphological features (Gavrilović *et al.* 2005); 4) Mlava spring (Beljanica Mt., eastern Serbia) as the largest spring in the Carpathian karst of Serbia and an historically important site for the development of karstology as a science (initially explored by J. Cvijić, 1893, proposed by Z. Stevanović); 5) Bogovina Cave (Boljevac vicinity, Kučaj Mt., eastern Serbia) as the largest cave in the Serbian Carpathians, temporarily hydrogeologically active (proposed by Stevanović Z., *pers. comm.*, 2010);

6) Risovačka Cave (near Arandjelovac, central Serbia) that simultaneously signifies karstic features and a paleontological-archeological site (the Paleolithic); 7) Scarns of Jaram (Kopaonik Mt., south Serbia, Milovanović *et al.* 2005); and 8) the site of Drmno (Kostolac, central Serbia) with a complete mammoth skeleton (*Mammuthus cf. trogontherii*) conserved *in situ* (proposed by Marković Z., *pers. comm.*, 2010).

Nationally important geosites (NIG)

The majority of geosites belong to this category and they have been used as reference sites by the Serbian geological community. This category includes: historically important sites for the development of geology as a science, scientifically significant geological and geomorphological features (type sections of geological units, fossiliferous localities, illustrations of tectonic and volcanic processes, unusual mineral occurrences, significant geological features for paleogeographic and paleoclimate reconstruction, representative example of landforms and effects of weathering, erosion or deposition on landform evolution) and sites of exceptional natural beauty. These sites have to be recognized within the Register of nationally significant sites.

From the paleontological point of view, fossiliferous sites such as the Prebreza (southern Serbia) and Brajkovac near Valjevo (western Serbia) are



Fig. 3. - Geosite Kotroman (Mokra Gora, western Serbia) - the Albian- Cenomanian deposits – Cretaceous "basal series".

proposed as nationally important geosites. They contain various well-preserved remains of terrestrial mammals (the Miocene) that allow correlation with other similar-aged sites across the Balkans, Europe and Asia. Particular sites in the Mokra Gora vicinity (e.g. Kotroman, Ogradjenica and Popovo Brdo) (Fig. 3) are also assigned this rating, displaying specific paleoenvironmental conditions and the evolution of life during the Upper Cretaceous. The Karagača stream (Vrčin, Belgrade vicinity) can also be added to this category as one of the first discovered geological sites in Serbia and stratotype section of the *Serbian substage* (Stevanović 1990) as can Đavolja Varoš/Devil Town (Radan Mt., south Serbia), a unique site in Serbia which includes impressive pyroclastic andesite rocks, erosion landforms and mineral springs.

Considered to be of national significance, localities within the Fruška Gora National Park, that will be nominated as the first geopark in Serbia, are also potential geotourism sites (e.g. Čerević stream, Srednje brdo, Janda, the open-pit mine “Filijala”, Veliki Surduk, etc.). To this category can be assigned some Paleozoic localities in western Serbia (e.g. Mili-vojevića quarry/Družetić, Likodra thrust and Soko Grad, near Krupanj), several geosites in Stara planina National Park (e.g., the Permian red beds of Topli Dol Formation in Temska, Upper Jurassic development “Acantic beds” in Rsovci, Jurassic-Lower Cretaceous section in Novo Korito syncline, Lower Cretaceous section in Sukovo village near Pirot) as well as the “Ljig flysch”, “Ophiolites of Rujevac” (western Serbia), and the Titel loess (Vojvodina).

Regionally important geosites (RIG)

These sites include geological and geomorphological features representative of regions (regional significance) or smaller areas in a region (local significance). More than 200 localities can be identified as regionally or locally important geosites. Some of them have been already put under protection as natural monuments such as the Cretaceous deposits at “Mašin majdan” (Topčider/Belgrade) (Fig. 4) or the Miocene (Neogene) sediments below the Kalemegdan fortress (Belgrade downtown).

MOVABLE (EX SITU) GEOHERITAGE

The movable geoheritage are specimens of rocks, minerals and fossils that represent individual phenomena grouped by their systematic position, age range or by the site where they were recorded. One way to conserve movable geoheritage is to form geological collections. In Serbia, geological collections constitute a large part of all natural history collections and,

together with geosites, offer valuable information for the interpretation of major events in the development of the earth and life.

Geological collections can be formed gradually by collecting the material during field research, but may also be acquired by exchange or sale, or as legacies. The documentation on the geological collections (field books, collection books/books of incoming material, labels, books of outgoing material, inventory books and inventory cards) represents their complementary part. Each identified specimen has a label which holds essential information, including the date and location of its collection and the name of its collector. In addition, each specimen has a unique



Fig. 4. - Fossiliferous site “Mašin majan”, Topčider/Belgrade (geosite no. 19) illustrates Cretaceous marine deposition with well preserved invertebrate fauna (the Urgonian and Maastrichtian age).

registration number which is used to keep track of the specimen and its associated information. Without this contextual information a meaningful study of the object can be very difficult. The collections accomplished full scientific value and importance only with the proper archiving of data.

The conservation of the geological collections includes systemic and museological research, and scientific data processing, application of various methods of processing and conserving, as well as the provision of optimal storage space (Maran 2000). Usually, geological collections are classified as petrological, mineralogical and paleontological, based on the phenomena that the objects depict. According to the taxonomy and

chronostratigraphy, paleontological collections are, therefore, divided into the Paleobotany and Paleozoology Collections, (e.g. Collections of the Paleozoic, Mesozoic and Cenozoic invertebrates, Tertiary vertebrates and many others).

In Serbia, geological materials are housed in different institutions conducting geological investigations. The most important geological collections have been established as the result of long-lasting geological investigations and museological works, containing specimens from the territory of Serbia, former Yugoslav republics and other parts of the world. They are kept in the Natural History Museum in Belgrade (NHM Belgrade), Faculty of Mining and Geology, Belgrade University (FMG), the Serbian Geological Survey and NIS-Nafta-Gas. For instance, the NHM and FMG house initial collections from the 19th century that are linked with the founders of Geology and Natural sciences in Serbia. These specimens signify geological and museological rarities because they derived mostly from sites which have been destroyed or are no longer accessible and represent an important resource which cannot be replaced (Maran 1998).

The significance of geological specimens is viewed from different aspects. Starting principles for evaluation of geological collections are based on the attributes of a particular specimen (object), including how unique and representative it is, how instructive it is in terms of the evolution of inanimate and animate nature, natural process and form, and how important it is for the development of geology and natural sciences in Serbia (Maran 2005). The geological significance of an object is recognized at the global, national and regional (local) levels and accordingly three categories of geological collections can be distinguished: category 1 (internationally important collection), category 2 (nationally important collection) and category 3 (regionally or locally important collection). Although the criteria for evaluation of geological collections have been proposed and put into practice (Maran 2000, 2005), they have not yet been officially agreed. However, the significance rating assigned to an object has to be periodically reassessed in light of new information.

Category 1 - Collection of international importance

A collection of the first category (Category 1) includes specimens of international (global) significance such as holotypes and unusual and/or rare fossils, minerals and petrological appearances.

Holotypes or type materials have the status of a standard in accordance with the International Classification Codes (International Code of Zoological

Nomenclature, International Code of Botanical Nomenclature and IMA List of minerals²). A holotype is the best preserved single specimen of a newly discovered fossil species whose record the author of that species has named, described, photographed and published in an internationally recognized journal. Unidentified representatives of a species are compared to holotypes to see whether or not they can be described as belonging to the species represented by the holotypes. Identification data for holotypes are: origin of the name (*derivation nominis*), the site where it was found (*locus typicus*), stratigraphic level and lithology of sediments from which the holotypes originates (*stratum typicus*), inventory number, and the data of the collection where it is kept. When the holotype for a new species is not designated, the specimens from the type series - syntypes - enjoy an equal taxonomic status. Lectotype, or a chosen type, is a 'holotype' subsequently selected from the syntypes. A lectotype is selected on the same principles as a holotype. A mineral holotype represents a single specimen, designated by the scientist describing the new mineral, from which all of the necessary data for the original description was obtained. For instance, if parts of a mineral holotype have been exchanged with other museums, then each of these parts can be formally called part of the holotype.

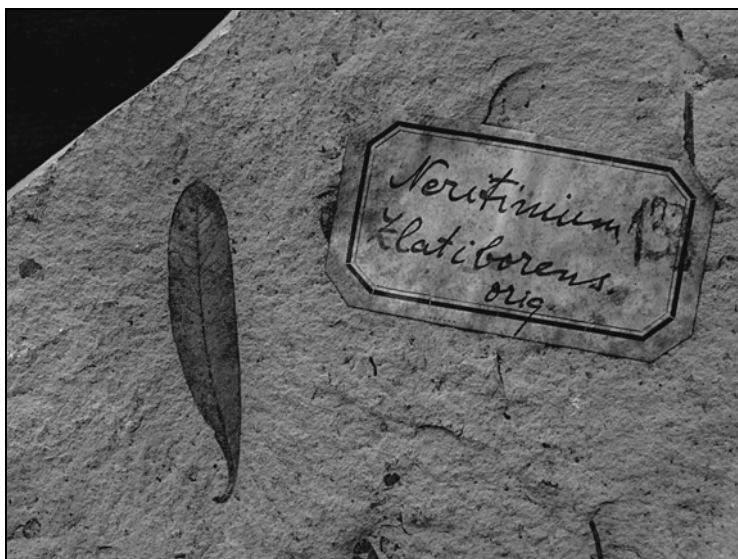


Fig. 5. - Holotype *Neritinium zlatiborens* Anić (the Oligocene-Miocene flora) from Kremna, western Serbia.

² International Mineralogical Association (IMA), among several commissions, also includes the Commission on New Minerals, Nomenclature and Classification (CNMNC), which main aims are to ensure that strict procedures are followed before new mineral species can be established and coordinates the procedures for classification of minerals.

For example, the Collection of holotypes in the Natural History Museum, Belgrade (Fig. 5) contains 500 specimens of new species of fossils discovered in Serbia. Apart from fossils, the type material also includes the new mineral species (e.g. Jankovičite IMA 1993-50³, Jarandolite IMA 1995-20³ and Jadarite IMA 2006-26³). As significantly important part of collections are designated rare but world-wide known minerals from the old mine “Stari Trg” - Trepča (e.g. ludlamite, plumosite and vivianite), well preserved petrological samples (e.g., the scarns from Kopaonik, the micaschists from Caričin Grad/Lebane) as well as the unique meteorites (from Jelica Mt., Sokobanja and Dimitrovgrad). The aforementioned material, covering all aspects of categorization, is invaluable and therefore enjoys special conservation measures.

Category 2 – Collection of national importance

The second category includes geological materials of national importance such as specimens first recorded at particular areas, fossils typical of certain time intervals (facial and zone fossils), material collected on sites



Fig. 6. - Lumachelle of fossilized bones (Middle Miocene) from Prebreza, south Serbia (geosite no. 14) Parts of jaws, horns and long bones of antelope (*Hypsodonthus serbicus* Pavlović), parts of lower jaws and teeth of boar (*Bunolistriodon meidamon* Fortelius, Van der Made & Bernor).

³ Date and number of registration of minerals within the International Mineralogical Association (IMA) List of minerals.

partly or entirely destroyed (geological rarities), specimens valuable for pursuing the historical development of earth sciences, and part of collections related to the founders of geology in Serbia. In this sense, certain parts of the Museum collections have particular value such as the petrological samples from the initial collections of A. Boue, J. Pančić, J. Žujović and P. Pavlović, fossil specimens from abandoned and destroyed sites (the Silurian graptolites from Zvonačka spa and Kučaj Mt., the Jurassic ammonites from Greben, Djerdap Gorge) or very rare mammal fossils from Prebreza (south Serbia) (Fig. 6) and Veles (FYR of Macedonia).

Category 3 - Collection of regional and local importance

A collection in the third category entails geological specimens collected in Serbia or in former Yugoslav republics, which were the referent material of varied monograph studies. Such material has potential significance for different scientific and educational purposes (review, retest of old theories and the development of new ones, student practice, subject of bachelor, master and doctoral thesis, etc.).

CONCLUSION

Geological sites and objects display various rock formations, structures, landforms and fossils that make a special contribution to the understanding and appreciation of the geological history of Serbia, which goes back more than 600 million years. Geoheritage sites are valuable from many angles. Professional geologists use the sites for research and reference. Geology teachers utilize accessible field areas as an important educational source. Amateur geologists and naturalists are interested in visiting and understanding sites. Geological collections also play an active role in the research, promotion, and protection of the geodiversity of Serbia. Although the majority of collections contain local specimens, some of the larger national institutions (the Natural History Museum in Belgrade, Faculty of Mining and Geology-Belgrade University, Serbian Geological Survey) house a wide range of specimens which are of national and international importance.

The choice of criteria for judging the significance of geodiversity (geoheritage) for conservation is considered the first stage in any assessment. In this regard, some basic principles are discussed, such as how representative and how unique or special the site/object is, its appropriateness (suitability) for correlation, its diversity (complexity), its vulnerability to damage or change, and its geological significance (international, national, regional and local level). Three categories of non-movable

geoheritage are proposed: 1) Internationally Important Geosites (IIG); 2) Nationally Important Geosites (NIG) and 3) Regionally Important Geosites (RIG).

The significance of geological specimens is analyzed from various points of view, including how unique and how representative they are as well as how instructive for the evolution of inanimate and animate nature, their natural process and form, and their importance for the development of geology and natural sciences in Serbia. Related to the significance of the geological specimens they comprise, three categories of collections are recognized: category 1 (internationally important collection), category 2 (nationally important collection) and category 3 (regionally and locally significant collections).

REFERENCES

- Alcala, L. (1999): Spanish steps towards geoconservation. *Earth heritage* **11**: 14-15.
- Alcala, L., Morales, J. (1994): Towards a definition of the Spanish palaeontological heritage. In: O'Halloran D., Green C., Harley M., Stanley M., Knill J. (eds): *Geological and Landscape Conservation*: 57-61. - Proceedings of the Malvern International Conference 1993, Geological Society of London.
- Burek C. V. (2005): History of RIGS in Wales: An example of successful cooperation for geoconservation. Geological Society of London, Special Publications **300**: 147-171.
- Burek, C. V., Potter, J. (2004): Local Geodiversity Action Plans - Sharing Good Practice Workshop Peterborough, 3 December 2003. English Nature Research Reports **601**: 1-37.
- Dixon, G. (1995): Aspects of Geoconservation in Tasmania: A Preliminary Review of Significant Earth Features. Report to the Australian Heritage Commission, Occasional Paper **32**: 1-126.
- Gavrilović, D., Menković, Lj., Belij, S. (2005): Geomorphologic heritage sites. In: Karamata S., Mijović, D. (eds): *Inventory of the Geological heritage sites of Serbia*. Conference on Geological Heritage of Serbia: 25 [Proceedings]. - Institute for nature conservation of Serbia, Belgrade.
- Gray, M. (2004): *Geodiversity: Valuing and Conserving Abiotic Nature*. - John Wiley & Sons, Ltd, Chichester, UK, 434 pp.
- Joyce, E. B. (1994): Assessing the significance of geological heritage sites: from the local level to world heritage. In: First international symposium on the conservation of our geological heritage, Proceedings. - *Memoire de la Societe Geologique de France, Nouvelle Serie* **165**: 37-43.
- Maran, A. (1998): The role of Natural History Museum in Serbia's geo-heritage conservation. In: Anonymous: 13th Congress of geologists of Yugoslavia, Herceg-Novi 2: 325-334 [Proceedings]. - Herceg Novi.

- Maran, A. (2000): Documentation and categorization of paleontological collections as geoheritage objects of Serbia. Protection of nature, Institute for nature conservation of Serbia, Belgrade **52** (1): 117-122.
- Maran, A. (2005): Kriterijumi za kategorizaciju i evaluaciju objekata geonasledja Srbije – paleontološke zbirke i lokaliteti [Criteria for categorization and evaluation of Serbian geoheritage objects - paleontological collections and sites]. Arhiva Prirodnjačkog muzeja, Beograd, 1-15. (manuscr.)
- Maran, A. (2008): Geoconservation in the Balkan region: practices and legal instruments. Bulletin of the Natural History Museum, Belgrade **1**: 41-63.
- Milovanović, D., Cvetković, D., Resimić, K. (2005): Magmatic and Metamorphic rocks. In: Karamata S., Mijovic D. (eds): Inventory of the Geological heritage sites of Serbia. Conference on Geological Heritage of Serbia: 24 [Proceedings]. – Institute for nature conservation of Serbia, Belgrade.
- Pena dos Reis, R., Henriques, H. M. (2009): Approaching an Integrated Qualification and Evaluation System for Geological Heritage. Geoheritage **1**: 1-10.
- Prosser, C. (2002a): Terms of endearment. Earth Heritage **17**: 12-13.
- Prosser, C. (2002b): Speaking the same language. Earth Heritage **18**: 24-25.
- Prosser, C. (2005): Conserving England's geodiversity: making the transition into Natural England. English Nature, 14 pp.
- Rabrenović, D., Maran A. (2005): Jurassic age. In: Karamata S., Mijovic D. (eds): Inventory of the Geological heritage sites of Serbia. Conference on Geological Heritage of Serbia: 21 [Proceedings]. – Institute for nature conservation of Serbia, Belgrade.
- Scott, P., Roche, D., Nicholas, C., Lawrence, D., Ambrose, K. (2008): Creating Environmental Improvements through Geodiversity. In: Drew A., Roberts, N. (eds): Sustainable Aggregates. Theme 3 - Creating Environmental Improvements, 80 pp.
- Sharples, C. (1993): A methodology for the identification of significant landforms and geological sites for geoconservation purposes. – Report to Forestry Commission, Hobart, Tasmania, 31 pp.
- Sharples, C. (1995): Geoconservation in forest management - principles and procedures. Tasforests **7**: 36-50.
- Stanley, M. (2007): Developing a national GAP. Earth Heritage **27**: 18-19.
- Stevanović, P. M. (1990): Faciostratotipen in Bosnien, Serbien und Syrmien. In: Stevanović, P. M., Nevesskaya, L. A., Sokač, A., Jambor, A. (eds): Chronostratigraphie und Neostatotypen, Neogene der Westlichen ("Zentrale") Paratethys 8, Pontien: 439-457. – Jugoslawischen Akademie der Wissenschaften und Künste und der Serbischen Akademie der Wissenschaften und Künste, Zagreb-Beograd.
- White, S., Mitchell M. (2006): Geological heritage sites: a procedure and protocol for documentation and assessment. Geological Society of Australia, Special Publication **26**: 1-2.
- Wimbledon, W. A. P. (1996): GEOSITES - a new IUGS initiative to compile a global comparative site inventory, an aid to international and national conservation activity. Episodes **19**: 87-88.

- Wimbledon, W. A. P. (1998): A European geosite inventory: GEOSITE - an International Union of Geological Sciences initiative to conserve our geological heritage. In: Duran, J. J., Vallejo, M. (eds): Comunicaciones de la IV Reunion Nacional del Patrimonio Geologico, Miraflores de la Sierra (Madrid): 15-18. – Sociedad Geografica Espana, Madrid.
- Wimbledon, W. A., Ishchenko, A., Gerasimenko, N., Alexandrowicz, Z., Vinokourov, V., Liscak, P., Vozar, J., Vozarova, A., Bezak, V., Kohut, M., Polak, M., Mello, J., Potfai, M., Gross, P., Elecko, M., Nagy, A., Barath, I., Lapo, A., Vdovets, M., Clincharov, S., Marjanic, L., Mijović, D., Dimitrijević, M., Gavrilović, D., Theodossiou-Drandaki, I., Serjani, A., Todorov, T., Nakov, R., Zagorchev, I., Perez-Gonzales, A., Benvenuti, M., Constantini, E., D'Andrea, M., Gissoti, G., Guaddo, G., Marchetti, M., Massoli-Novelli, R., Panizza, M., Pavia, G., Poli, G., Zarlenga, F., Satkunas, J., Mikulenas, V., Suominen, V., Kananoja, T., Lehtinen, M., Gonggrijp G., Look, E., Grube, A., Johansson, C., Karis, L., Parkes, M., Raudsep, R., Andersen, S., Cleal, C., Bevins, R. (1998): A first attempt at a geosite framework in Europe - an IUGS initiative to support recognition of World Heritage and European Geodiversity. In: Zagorchev, I., Nakov R. (eds): Special Issue "Geological heritage of Europe". *Geologica Balcanica*, Sofia **28**(3-4): 5-47.

Relevant legislation

Law on cultural properties, Official Gazette of RS, No. 71/1994

Law on environmental protection, Official Gazette of RS, No. 36/2009

Useful links

Sharples C. 2002: *Concepts and Principles of Geoconservation*. PDF Document, Tasmanian Parks and Wildlife Service

www.dpiw.tas.gov.au/inter.nfs/webpages/SJON-57W4FD

IMA list of Minerals

<http://pubsites.uws.edu.au/ima-cnmnc/imalist.htm>

Natural History Museum in Belgrade

<http://www.nhmbeo.rs/pocetna/naslovna.1.html>

Institute for nature protection of Serbia

<http://www.natureprotection.org.rs/index.php?limitstart=14&lang=en>

ВРЕДНОВАЊЕ ГЕОЛОШКОГ НАСЛЕЂА СРБИЈЕ

АЛЕКСАНДРА МАРАН

Р Е З И М Е

Геодиверзитет представља разноврсност геолошких (порекло, састав и структура геолошке подлоге), геоморфолошких (облици рељефа) и педолошких (типови земљишта) феномена, који се реализују временски и просторно, као резултат унутрашњих и спољашњих геодинамичких сила и процеса. Геодиверзитет обухвата и разноврсне фосилизоване остатке биљака и животиња из различитих периода геолошке историје, који документују кључне фазе у еволуцији живог света на Земљи. С обзиром да је спектар објеката геодиверзитета изузетно широк, на основу приоритета, издвајају се оне геолошке вредности од значаја за науку, образовање и културу, које представљају геолошко наслеђе Србије. Упознавање укупног геодиверзитета Србије кроз проучавање и вредновање појединачних објеката (геонаслеђе) је основ за њихово рационално коришћење и адекватну заштиту.

Геолошко наслеђе Србије обухвата инструктивне покретне и непокретне објекте (феномени, облици и појаве). Репрезентативни примерци стена, руда, минерала и фосила су покретни (*ex situ*) објекти геолошког наслеђа. Непокретне (*in situ*) објекте геолошког наслеђа представљају репрезентативни локалитети (налазишта) и профили са јасно израженим геолошким карактеристикама, приступачни за истраживања и проучавања. Објекти који представљају геолошко наслеђе Србије, треба да буду објективно и прецизно научно објашњени (дефинисани).

Први корак у вредновању објеката геодиверзитета је правилан избор критеријума. Sharples (1993, 1995, 2002) наводи три основна критеријума: егзистенцијални значај (природна вредност је вредност сама по себи), еколошки значај (значај сваког појединачног објекта / феномена за одвијање свеукупних процеса у природи) и антропоцентрични значај. Критеријуми за вредновање објеката геолошког наслеђа Србије обухватили су основне карактеристике објеката (репрезентативност, јединственост, реткост и угроженост/рањивост) и њихов значај за настанак и еволуцију неживе и живе природе, природних процеса и појава, за развој геологије и других природних наука у Србији. Вредност и значај објеката геонаслеђа сагледани су на међународном, националном и регионалном (локалном) нивоу.

Непокретни објекти геолошког наслеђа Србије категоризовани су као: 1) локалитети од међународног значаја, 2) локалитети од националног значаја и 3) локалитети од регионалног (локалног) значаја. Покретни објекти геолошког наслеђа Србије груписани су у три категорије: 1) категорија 1 - збирка од међународног значаја; 2) категорија 2 - збирка од националног значаја и 3) категорија 3 - збирка од регионалног (локалног) значаја.