Geodiversity of Stara Planina Mountain: some sedimentary units

Геоа разнообразието на Стара планина: някои седиментни единици

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Stara Planina Mountain can be viewed from several perspectives, as a nature park and in terms of geography, geology and geodiversity, and also radioactivity. The present paper addresses areas of interest from the viewpoint of geodiversity related radioactivity. Generally speaking, Stara Planina Mountain is a complex geologic system, built up of different geologic units (with regard to the composition, characteristics and origin). From the north, where the geologic units are separated by tectonic structures and where granite and granodiorite intrusions crop out, the area is defined by faults that separate the Late Jurassic in the south from the Early Cretaceous in the north. Towards the south, there is a complex geotectonic assemblage made up of the Janja, Radičevo and Ravno Bučja granites; the Zaglavak gabbro massif; Paleozoic metamorphic rocks: Proterozoic–Cambrian, Silurian–Devonian – the Inovo Series and others; and Permian red sandstones and conglomerates. To the south, there are Mesozoic formations: Triassic (Kopren-Gostuša-Dojkinci), Jurassic (Basara, Odorovci), and Lower Cretaceous (Visočka Ržana, Dimitrovgrad). In the southern part of the Mesozoic block the Jurassic and the Cretaceous are intersected by structures with NW-SE orientation. The northern boundary of Stara Planina Mountain is not clearly defined and can be followed on the Zaječar and Bor maps along Cretaceous formations and intrusions over a length of about 30 km northward and farther via Brusnik and Brestovac to Negotin (Andjelković et al., 1977). In 1997, Stara Planina Mountain was designated a nature park, where there are a number of unique examples of geodiversity such as: Babin Zub, Arbinje and Rosomački Lonci briefly presented below.

Babin Zub ("Grandmother's Tooth") (Fig. 1A) is situated in Permian sediments, at the point of contact with Paleozoic metamorphic rocks and about 3 to 3.5 km east of the southern fringe of the Janja granite. This is a red sandstone formation comprised of continental sediments – arkose basal conglomerates (missing in places), sandstones, siltstones and shales. The thickness of the basal conglomerates varies, up to 200 m or more (Andjelković et al., 1977). They are built up of pebbles and coarse grains of quartz, feldspar (acidic plagioclase, rarely K-feldspar), granitoid rocks, low-crystallinity schists, Carboniferous andesites, dacites, diabases, and other rocks. These conglomerates passes upward with a gradual transition into coarse- and medium-grained sandstones and alternating fine-grained layered and thin-layered sandstones and siltstones. In the higher parts of the column the sandstones gradually disappear and the uppermost part of the Permian is represented by thin-layered to foliated friable siltstones and shales, showing traces of raindrops, bioglyphs and symmetric waves. These sediments are of an arkose nature, generally made up of quartz and feldspar, occasionally mica. They are bonded by illitic-hematitic cement with calcite and rarely kaolinite (up to 25%). The Permian sediments were formed over a relief mostly comprised of granitoid rocks, with some low-grade metamorphic crystalline schists, in an oxidizing environment and a warm and arid climate with occasional atmospheric precipitation. The thickness of the Permian sediments is up to 600 m. The "teeth" were probably formed during sedimentation, when more silica remained in the system (probably with $FeOH_3.nH_2O$, which was more reactive and previously reduced). Radioactivity measured 120 cps and 0.175 μSv/h.

Arbinje (Fig. 1B) – these are plates created by an Lower Triassic assemblage of red sediments and river flow. The older, Seisian age layers are comprised of coarse clastic sediments – quartz and sub-arkose conglomerates and sandstones, whose stratification is typically inclined ("motley sandstones"), which transgress Permian sandstones, albeit with no clear angular discordance, and lie below layers that contain Campilian age fauna. In the northwestern part of Stara Planina Mountain, Seisian sediments are overlain by younger Liassic deposits. The Seisian sediments are built up

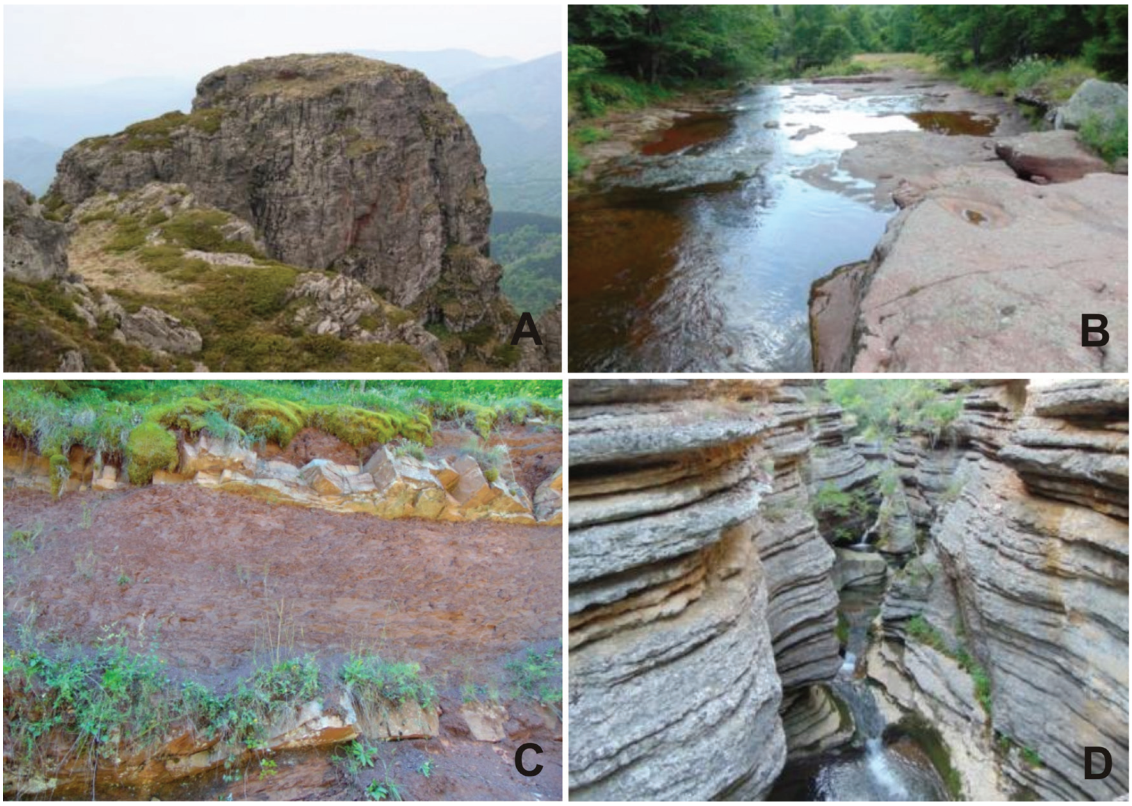

Fig. 1. *A*, typical relief of Babin Zub; *B*, sub-horizontal red sandstone "plates" at Arbinje; *C*, outcrop of red sandstone between banks of pink-gray siltstone; *D*, Rosomački Lonci

of basal quartz conglomerates and sandstones (quartz horizon), which upward turn into coarse-grained sub-arkoses (sub-arkose horizon) and medium-grained arkose sandstones. The grains are round and their composition is: 80–95% quartz, 5–20% microcline, rare acidic plagioclase, muscovite, biotite, and granite, quartzite and schist fragments. The matrix is clayey, in places mixed with hematite. The Seisian sediments are deposited in river valleys, deltas or riparian and shallow parts of the basin. Pot-like cavities of different sizes have been noted, formed by whirlpools with abrasive material. The radioactivity measured 110 cps and 0.180 μSv/h.

The Jelovica area features a full profile of the motley sandstones, including all lithologic units characteristic of this Lower Triassic sequence. In the beginning of the profile, the schists, exposed in the valley of the Jelovica River, are overlain by conglomerates and conglomeratic red sandstones, which alternate with red siltstones and gradually move to the Colorful Series. The Colorful Series contains red and greenish medium-grained sandstones. Red color is predominant in the lower part of the sequence, while greenish gradually becomes prevalent in the upward direction. This is especially true of the siltstones, with solely red siltstones in the lower part of the sequence and predominantly greenish in the upper horizons. Another characteristic feature of the Jelovica siltstones are continuous red layers, up to 3–4 m thick, and thin interbeds and lenses of gray siltstones. Fragments are often found in the greenish, gray and other sandstones. At times the concentration of these fragments is such that they become conglomerates (intra-formational conglomerates). Radioactivity is 130 cps and 0.192 μSv/h at area on Figure 1C.

Rosomacki Lonci – this locality is situated in Upper Jurassic limestones, at the contact with the Lower Cretaceous rocks, within a formation of "lumpy limestones" in a fault zone trending NNW-SSE (Fig. 1D). In the Upper Jurassic there is a complex of carbonate rocks with a considerable spread and thickness. The complex is built up of stratified and banked limestones, dolomitic limestones and dolomites. Based on the fauna and stratigraphic position, there are distinct Oxfordian–Kimmeridgian and Tithonian stages. Mainly considering the microfauna, there are two types of developments: foraminiferal-algal (neritic) and planktonal (pelagic).The radioactivity is low – 0.060 μSv/h.

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