Caves of Mt. Miroč (Danube Gorge, Eastern Serbia)

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Abstract

Mt. Miroč is located in Eastern Serbia, on the right bank of the Danube, in Djerdap (Iron Gates) gorge. The karst occupies approx. 120 sq. km, on a plateau with relatively low elevation (400 – 500 m a.s.l). Until 1990, when Student Speleologic and Alpinistic Club (ASAK) started its explorations, it was believed that Mt. Miroč lacks caves of considerable dimensions. However, several major caves have been explored on Miroč since then, including the deepest Serbian cave – Rakin ponor (-285 m). This paper presents the geological and hydrogeological characteristics of Mt. Miroč karst, and the results of the speleological explorations perfomed so far. The explorations set focus on some interesting questions concerning the caves of Mt. Miroč: 1) The deposition of manganese oxides at the lowest part of Buronov ponor cave, which indicates the past oscillations of water table; 2) The source of CO2 and the ciclicity in its concentracion in Nemački ponor cave, the only cave with significant CO2 ocurrence in Serbian karst; and 3) The speleogenesis of the caves in the area, and succession and mutual influence of events, viewed in conjunction with the uplift of Mt. Miroč and incision of Djerdap Gorge which drained the Panonian sea into the Dacian bassin.

Introduction

Mt. Miroč karst was only partially explored until 1990, when Student Speleologic and Alpinistic Club (ASAK) started the explorations of Mt. Miroč caves. After ten years of explorations, Mt. Miroč hosts four out of six deepest Serbian caves (including the deepest one, Rakin ponor), and also two out of ten longest caves. Compared with other karst areas in Eastern Serbia, Mt. Miroč apparently does not have outstanding features. However, favourable conditions led to a formation of numerous significant caves.

Geological and hydrogeological setting

On its path from the Panonnian basin towards the Black sea, the Danube flows across the Carpatho-Balkanides mountain range, through the Djerdap gorge. Mt. Miroč is located at the downstream part of the gorge, on its narrowest part (named Kazan), on the right river bank. Most of Mt. Miroč is located in the Djerdap National Park. Mt. Miroč karst is located on a plateau at 400-500 m a.s.l., with peaks overpassing 600-700 m. The karst occupies some 120 km^2 of a meridionally elongated area with well defined contact along the western and eastern boundary with surrounding non-karstic rocks.

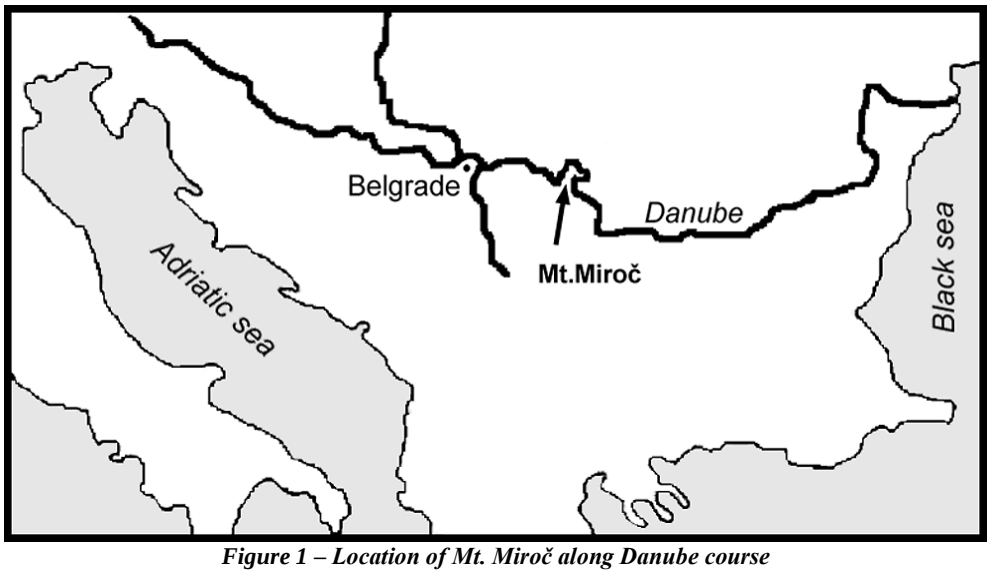

Figure 1 – Location of Mt. Miroč along Danube course

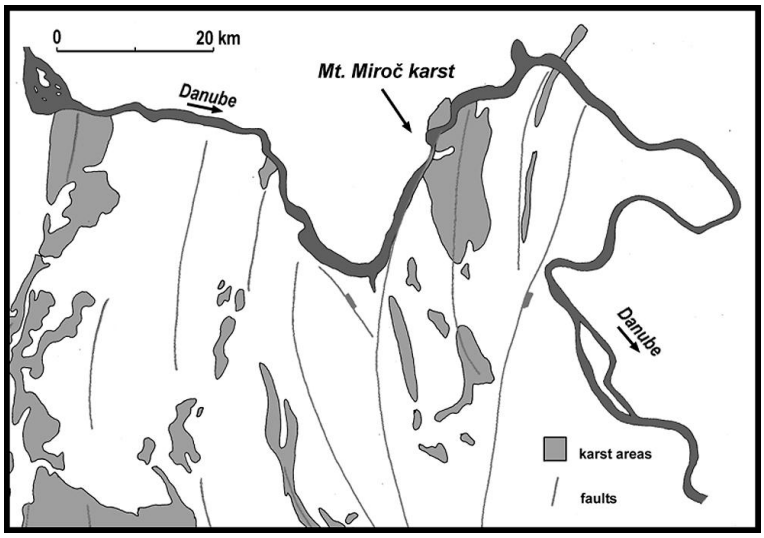

Figure 2 – Karst areas in the Djerdap gorge. Only small part of Miroč karst continues on the left river bank. (MENKOVIĆ 1995)

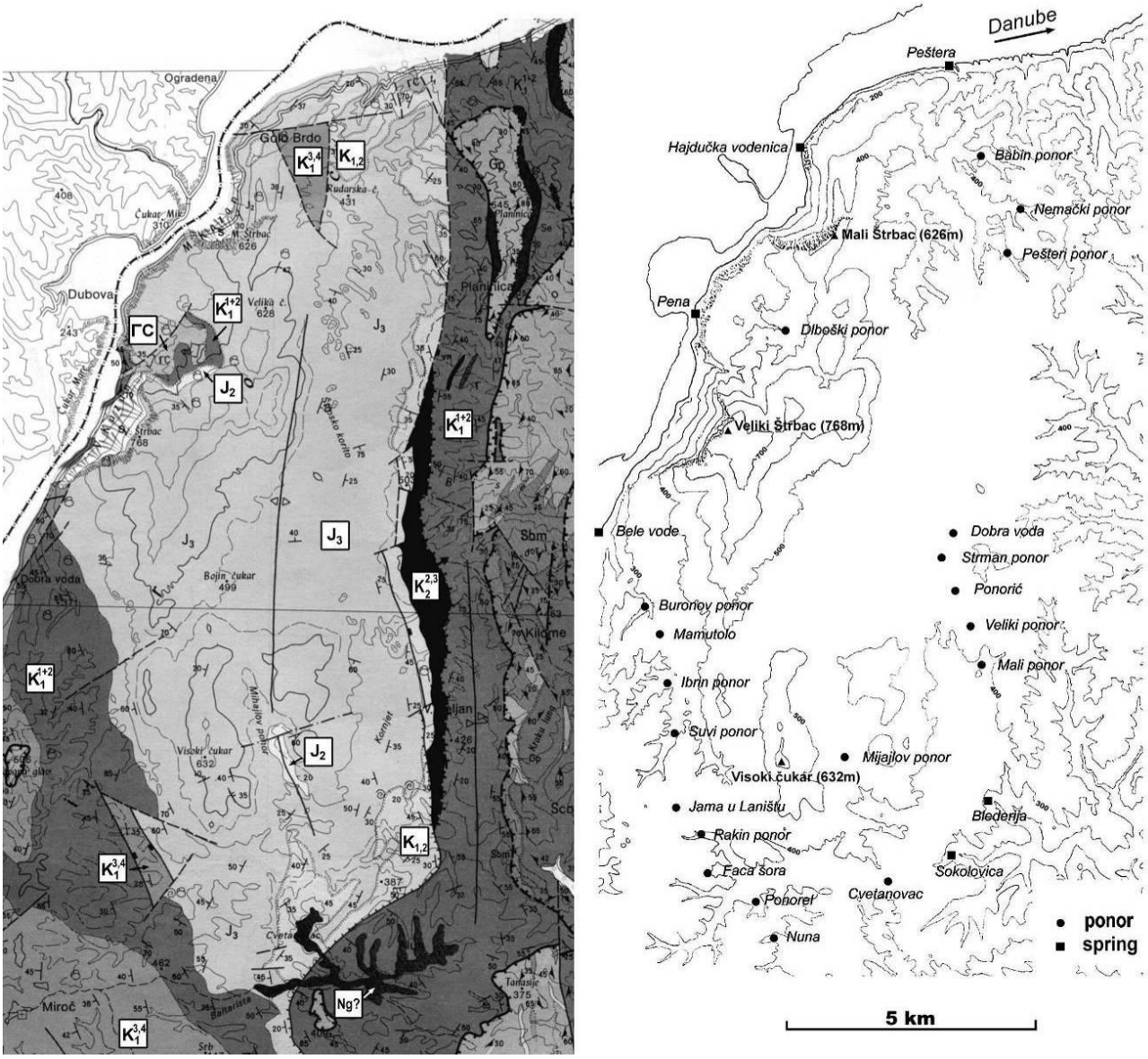

Figure 3 – Geological map of Mt. Miroč karst (left) and Situation map of ponors and springs (right)

As a structural unit, Mt. Miroč is a N-S oriented anticline plunging gently towards North, composed mainly of massive limestones (J_3) up to 300 m thick. Non-karstic rocks outcrop in a small extent, as Middle Jurassic conglomerates and sandstones at the central part, and also as Hercynian granites and chlorite-sericite schists exposed by erosion on NW part of Mt. Miroč. Lower and Upper Cretaceous limestones, marlstones, shales and sandstones lie conformably in succesion on the limbs of the anticline. The eastern limb is disrupted by a normal fault of N-S orientation, to the East of which there are Proterozoic schists of the Gethic nappe.

The non-karstic rocks surrounding Mt. Miroč karst lie on slightly higher elevation, and numerous short periodic streams flow from them sinking along the western and eastern contact, mostly in caves. Due to an artificial accumulation of Djerdap lake, the water level was risen for approx. 20 m (to 70-75 m a.s.l), submerging four springs which drain most of the aquifer towards the Danube (with minimum discharges 10-20 l/s and maximum ranging from 1 to 2 m^3/s). Unfortunately, tracing tests and detailed analyses have not been performed before the submersion of these springs. The SE part of Mt. Miroč karst is drained towards the springs Sokolovica and Blederija, the latter having both cold and sub-thermal waters (17.5^{o}C) with gas pulsations (STEVANOVIĆ, 1997).

The Caves

All of the major caves on Miroč are ponor caves, with both vertical and horizontal portions. Outflow caves are known only at the springs Sokolovica, Bele vode (partially submerged) and Peštera (totally submerged, known only from reports by CVIJIĆ, 1921). Few small fossil (dry) caves are known, but it must be noted that the central part of the plateau, where fossil caves are expected, is still unexplored.

Most of the ponor caves are lined along the western and eastern contacts, and can be viewed as parts of two drainage systems. The terminal caves along the contact zones (Buronov ponor, on the western, and Nemački ponor on the eastern contact zone) reach main horizontal conduits. Their assumed outflow caves are Bele vode, and Peštera, respectively. The ponor caves on Mt. Miroč can be identified as high-gradient vadose inlets (Ibrin ponor, Jama u Laništu, Rakin ponor, Faca šora) and low-gradient vadose inlets with perched sumps (Buronov ponor, Suvi ponor, Veliki ponor, Nemački ponor), as defined by WORTHINGTON (1991). Water table is reached only in two caves (Rakin ponor, with inundated steep phreatic passage at 124 m a.s.l, dived to 95 m a.s.l, and Buronov ponor, with active passages with sumps at 93 m a.s.l).

Cave	length (m)	depth (m)
Bele Vode	304	14
Buronov ponor	2.400	187
Mamutolo	80	-
Ibrin ponor	855	239
Suvi ponor	930	133
Jama u Laništu	710	272
Rakin ponor	684	285
Faca šora	-	approx. 150
Sokolovica	283	-
Veliki ponor	536	92
Pešteri ponor	59	-
Nemački ponor	3.422	210
Gaura Ra	185	-

Table 1 – Most important caves of Mt. Miroč karst

Rakin ponor is the deepest explored cave in Serbia. In September 2000 it was dived by speleodivers from SOB caving club to the current depth of 285 m. The level of the inundated phreatic passage at the bottom lies approx. 55 m above the Danube accumulation. Cave Jama u Laništu has the highest entrance of all the ponor caves on Mt. Miroč. It is a deeply incised vadose cave, cascading without distinctive horizontal tiers. Its bottom is 44 m above the water table reached in a nearby Rakin ponor.

Suvi ponor, the third longest cave on Mt. Miroč, ends in a perched sump in a horizontal gallery wich drains the smaller inlets along the stream bed above the cave. Adjacent Ibrin ponor cave has both vertical and horizontal parts and ends without reaching the water table.

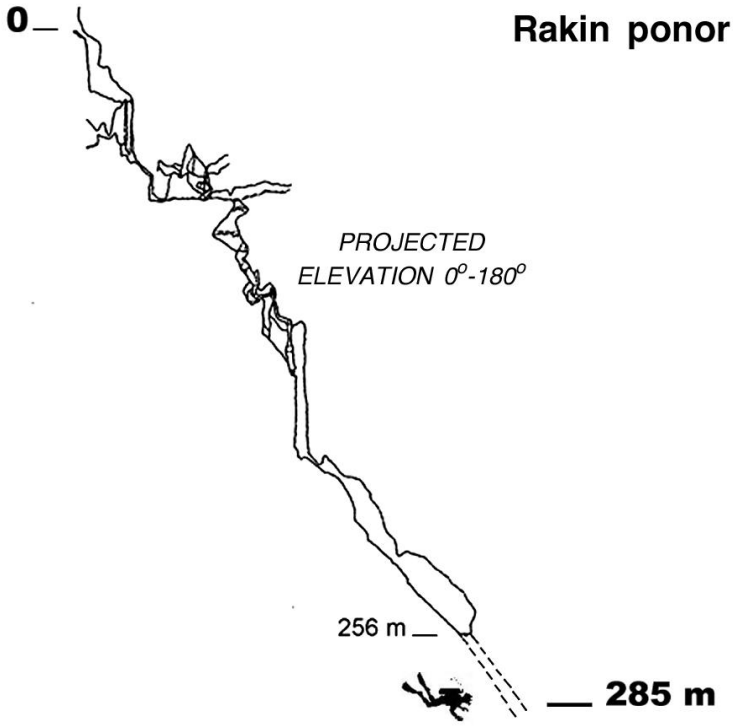

Figure 4 – Rakin ponor

Buronov ponor is the last of the ponor caves along the western contact. It has two distinctive horizontal tiers. The upper part (Elephant walk) is filled with sediment of unkown depth almost to the roof wich displays forms of phreatic origin (ZLOKOLICA-MANDIĆ & MANDIĆ, 1997). The Rio Bravo passage might be the fossil tributary connected with upstream ponors. The lower parts of the cave, Rio Negro and Mammoth gallery, show traces of periodic inundation. They lay 15 m above active conduits, visible at several parts interconnected by siphons. The observed stream is estimated at 0.5 m^3/s in the dry part of the year, and it is presumed that it feeds the springs at Bele Vode.

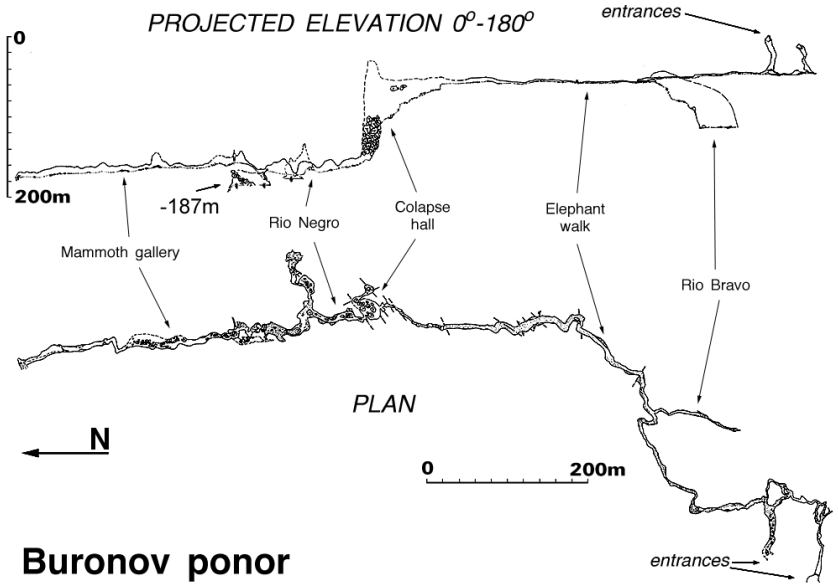

Figure 5 – Buronov ponor

The caves along the eastern contact are mostly impenetrable due to tectonic disruption. Nemački ponor, the last along the contact, is the longest cave on Mt. Miroč. It drains few adjacent ponors. At its bottom there is a horizontal passage 2400 m long, approx. 100 m above the Danube accumulation. It is covered with sediments of unknown depth, and ends in perched sumps. It is presumed that it drains towards now submerged Peštera outflow cave. According to CVIJIĆ (1921) allogenic schists exist in the Peštera cave, and they probably originate from the contact area of Nemački ponor (contact with Proterozoic schists).

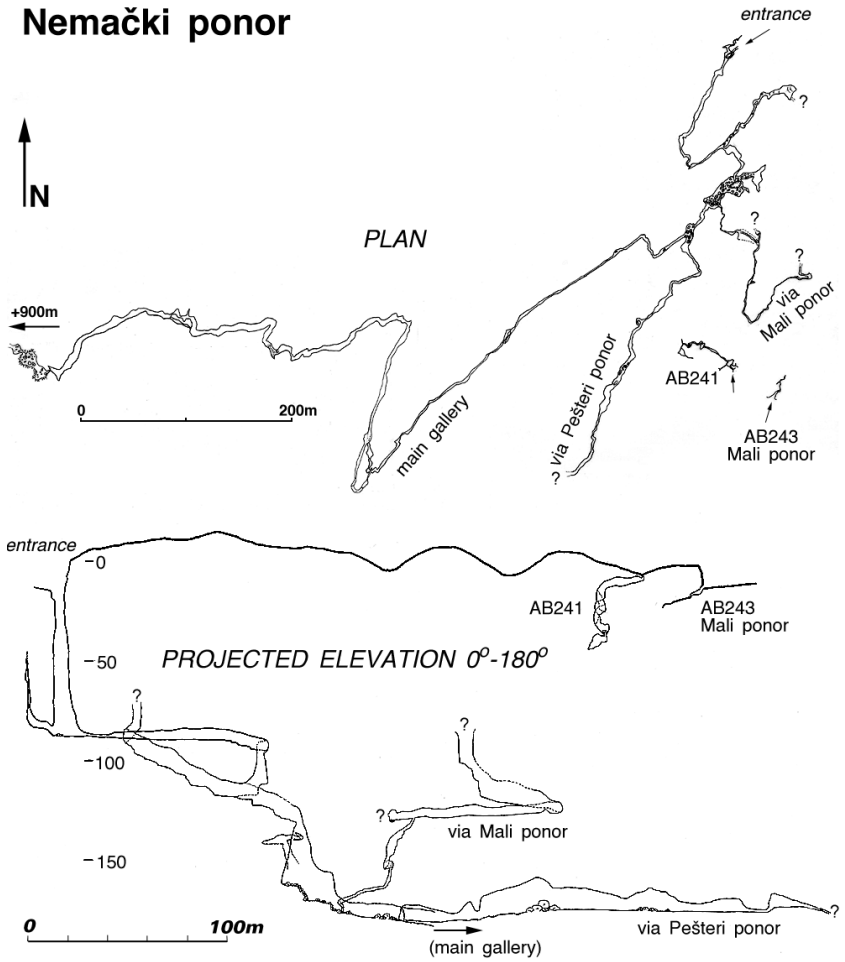

Figure 6 – Nemački ponor

Peculiarities

Some of the interesting questions wich have arisen after the explorations of Mt. Miroč caves are:

The passages in the lowest parts of Buronov ponor cave are completely covered with thin crust of Mn oxides. That indicates complete inundations of that part of the cave, since Mn oxides are deposited only at water-air interface level. Banded Mn layers on speleothem cross sections indicate the ciclicity in deposition. Dating of speleothems can explain the time and magnitude of events which caused such large and lasting oscillations of water level in the vicinity of a major river.

In Nemački ponor cave, CO_2 concentration is increased in the last 1000 m of the main gallery. In springtime (after snowmelt) the concentration drops. The analyses of air and water in the cave are yet to be performed, in order to determine the source of CO2. Is it originated by organic decay, or from (possibly sub-thermal) waters emerging in that par of the cave?

The speleogenesis of Mt. Miroč caves is of special interest, viewed in conjuction with the uplift of Mt. Miroč and incision of Djerdap Gorge. A final answer on the formation of Djerdap Gorge does not exist, so the solution of speleogenesis in the area might lighen up the problem of incision of Djerdap Gorge. Which was the sequence of events? Which paleoaquifer drained the area? Why the low-gradient passages in the caves show no correlation with river terraces?

References

CVIJIĆ, J. 1921. Djerdapske terase. *Glas Srpske Kraljevske Akademije*, CI, prvi razred, 43, Beograd: 1-33.

MENKOVIĆ LJ. 1995. Geomorfološka karta Srbije 1:500.000 (Geomorphological map of Serbia 1:500.000). *Geografski institut "J. Cvijić" SANU*, Beograd

MILOSAVLJEVIĆ A. 2000. Results of SOB caving club speleodiving explorations of Mt. Miroč. *(personal communication)*

STEVANOVIĆ Z. 1997. Characteristics of karst areas in Djerdap zone. *Geology of Djerdap area,* Geoinstitut special publication No 25, Beograd: 181-190

WORTHINGTON S.R.H. 1991. Karst hydrogeology of the Canadian Rocky Mountains. *McMaster University,* Ph.D. thesis: 370p

ZLOKOLICA-MANDIĆ M. & MANDIĆ M. 1997. Buronov ponor. *Proceedings of 3rd Symposium on karst protection,* Beograd: 245-253