

HYDRO CHEMICAL REGIME OF THE KARST SPRINGS ON THE MOUNT SUVA PLANINA IN EAST SERBIA

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ABSTRACT

The paper presents the results of the research of physical-chemical properties of groundwater from karst aquifer formed within the carbonate rock complex of the massif Suva Planina. Groundwater from this aquifer is drained through powerful karst springs that appear on the hillsides of the massif. With regard to geology, researched area distinguishes with compound geological fabric and compound tectonic relations that predisposed certain hydrogeological properties of the terrain.

Key words: massif, karst, aquifer, chemism

INTRODUCTION

Suva Planina belongs to mountainous area of southern Serbia. With the altitude over 1800 m.a.s.l., it is one of the highest mountains in this area. It is characterized with indented relief, distinguished erosion processes that are

conditioned by geological feature of the terrain. It is surrounded by Zaplanje's and Koritnicko-Babusnica's depressions along which flow the Koritnica and the Luznica. The altitudes of these depressions range between 400 and 500 m.a.s.l. Apart from some local roads Suva Planina is hardly passable (figure 1).



Figure 1. The landscape of Suva Planina

Basic Geologic-Tectonic Properties of the Terrain

The area of Suva Planina distinguishes with compound geological fabric and compound tectonic relations. Rock complex from Paleozoic distinguishes as the oldest litho-stratigraphic unit. It is represented by the series of schists, conglomerate, sandstone, diabase, sillstone, and chales. Rock complex from Mesozoic is represented by Triassic,

Jurassic, and Cretaceous. The most prevailing are Cretaceous sediments. They consist of rock complex made of limestone, and dolomite as well as of flysch series made of conglomerate, sandstone, and sillstone. Jurassic sediments are much more spread than Triassic ones, especially in the region of both anticlines of Suva Planina. They are represented by heterogeneous clastics sediments and

carbonate sediments. Triassic sediments occupy little space and are discovered only on the wings of anticlines of the mountain. They are represented by conglomerate, sandstone and limestone. Hillsides of the massif are made of Neogenic strata such as Paleocene, Miocene and Pliocene sediments. Zaplanje's and Korito-Babusnica's depressions are made of this complex, which consists of sand, clay, pebble, marl, conglomerate and sandstone. With regard to the tectonics, the massif distinguishes with compound tectonic relationships that are characterized with numerous faults of different directions of ranging. The dominant structural form is the anticline that ranges from northeast towards southeast. Its length along the axis amounts 30 km. All the same, it is one of the longest anticlines in eastern Serbia. Its core is made of formations from Paleozoic of middle Jurassic, while its wings are made of formations from upper Jurassic and lower Cretaceous. Overall, it is deformed by longitudinal and lateral faults. Regarding geotectonics, the area of Suva Planina belongs mostly to Carpathian-Balkan range and partly to Rodop i.e. Serbian-Macedonian mass made of crystal schist.

Hydrogeological Properties of the Terrain

Basic rock complex of Suva Planina is made of carbonate complex of Jurassic and Cretaceous ages, which is mostly tectonically damaged. All the same, from the aspect of drainage and accumulation of groundwaters, it is the most

significant complex. It is taken by deep processes of karstification resulting in the dissolution fracture porosity formed within. Such intensively developed system of porosity enables forming of one powerful karst aquifer with significant amounts of groundwaters. The resources of these waters are in function of hydrological agency, which affects the regime of their effluence. According to the data from the nearest meteorological station, middle term average precipitation for this area amounts 850 mm. Precipitations infiltrate over the whole surface of the massif, which represents one open hydrogeological structure providing good conditions for water exchange. In this way are formed dynamic reserves whose intensities of effluence are the greatest in spring and autumn. The occurrences of springs are bound to the lowest erosion parts of the terrain and they appear on the contact of water permeable karst and water impermeable nonkarst rock complexes. In this case, it applies to flisch complex from Paleozoic or Neogene that are predisposed by certain structural elements, first by faults along which appeared effluence of the ground flow (figure 2). The strongest drainage of the karst massif of Suva Planina generates through the springs Mokra, Divljana and Ljubradja. Their middle term average discharge amounts 0.4 – 0.9 m³/s. With regard to the way of emerging, they are of spillway type. When solving the problem of municipal water supply these springs are of extraordinary significance.

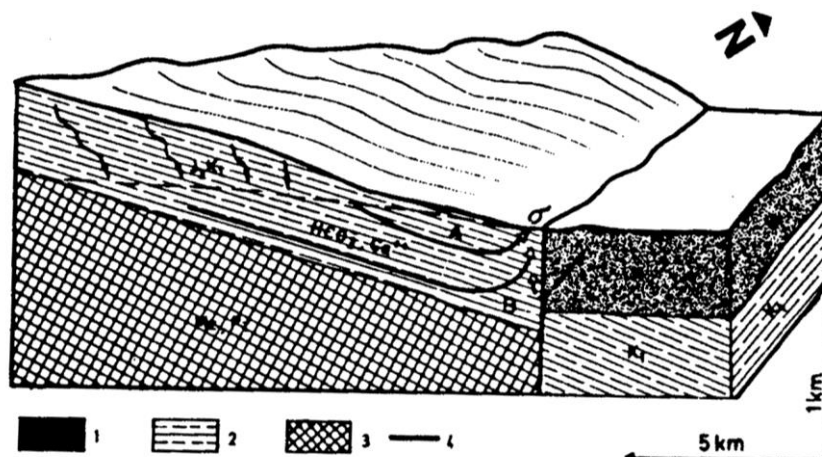


Figure 2. Hydrogeological model of the area

Physical – Chemical Properties of the Waters from Karst Springs and Their Regime

Researches of physical- chemical properties of the waters from karst springs were carried out at the springs Mokra, Divljana and Ljubradja. Their sum results during one hydrogeological year are shown in semi-logarithm diagram (figure 3). According to the content of anions and cations (table 1), analyzed waters from these springs belong to HCO₃-Ca type of water which refers to already presented conclusion that they are formed in carbonate rock complex (figure 4). Their temperature regime is unstable and is liable to seasonal changes. Average annual temperature of the water amounts 11.4 – 15.2°C at the air temperature of 11 – 17.5°C. Such a temperature ratio points out the existence of deeper shallow waterbearing layers of the aquifer within the frames of faster and weaker water exchange.

According to the content of Ph ions which amounts 7.3 – 7.4, the waters from analyzed springs are of neutral character. Evaluated E.C. is 385 – 404 s/cm, while Eh is 452 – 487 mV. The content of dissolved O₂ is 8.4 – 10.2 mg/l. According to the degree of hardness, which amounts 12.6 – 15 dH, these waters belong to very hard waters (after Klut). As for other chemical elements, heavy metals were followed and only Cu and Zn were registered in traces. The content of organic ingredients was registered in negligible concentration, which characterizes very pure waters. Carried out analyzes and followed chemical regime of mentioned springs clearly point out that waters from these karst springs can be utilized for municipal water supply of population and settlements that gravitate in this area. All the same, they can be bottled as natural stone waters. Their ecological environment proved such a statement.

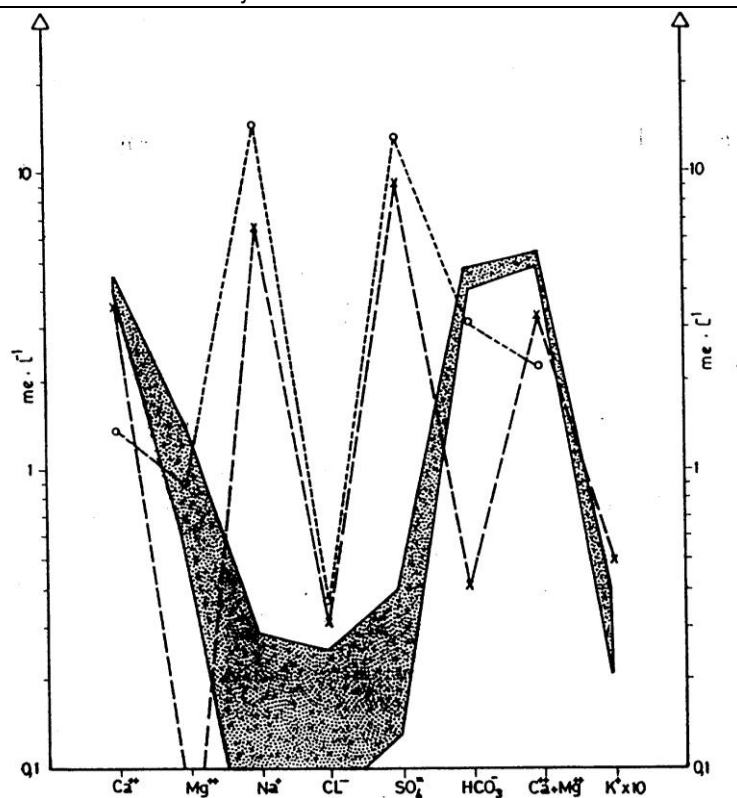


Figure 3. Semi-logarithmic diagram of hydrochemical analyses of karst springs: Mokra, Divljana and Ljuberađja

Table 1. The content of the anions and cations in karst springs (mg/l)

Spring	HCO ₃	Cl	SO ₄	Ca	Mg	K	Na
Mokra	335.3	5.2	10.7	90.5	7.0	0.7	3.2
Divljana	291.0	3.5	8.4	85.0	5.3	0.7	1.2
Ljuberađja	337.3	5.3	12.8	91.4	8.3	0.7	5.2



Figure 4. The rock complex of Suva Planina

CONCLUSION

Karst aquifers of the massif Suva Planina represent an accumulation of groundwaters whose reserves incessantly recharge. It empties through springs and wells that exist at the bottom of the Massif. One-year research of the quality of chosen springs proved that the quality of their waters was very suitable for human's utilization, which is contributed by ecologically saved environment.

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