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Extended Abstracts

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Hydrogeochemical characteristics of mineral and thermal waters

title: **Thermomineral groundwaters of Mataruska banja spa, Central Serbia**

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The Mataruska Banja Spa is situated in central part of Serbia, 180 km south of Belgrade at the foot of Stolovi Mountain, on the right bank of the Ibar River. The spa is situated at an altitude of 215 m and is characterised by moderate continental climate. The mean annual temperature amounts 12°C, while the mean sum of precipitation for many years amounts 761 mm.

Thermo mineral springs at the territory of the spa were discovered by chance after the big flood in the spring of 1898. The Ibar River turned from its watercourse right and made a new bed, closer to the mountains. Hot water smelling of sulphur occurred at the place where the Ibar River had made a new temporary bed. The increased percentage of sulphur hydrogen presence is one of the basic reasons of healing properties of Mataruške Banja thermo mineral waters.

Serpentinite and hydro thermally altered serpentinite of the Palaeozoic age represent the basic rock mass of which the terrain is constituted. Hydro thermally altered serpentinite represent a water-bearing formation of thermo mineral water where a fissure aquifer has been formed. A fissure aquifer within hydro thermally altered serpentinite is recharged predominantly by infiltration from precipitation. The circulation of thermo mineral water formed in deeper zones of the fissure aquifer takes place in fissure systems of younger faults and along fault zones within both kinds of serpentinite. It is supposed that there is a primary collector of thermo mineral water within limestones of Triassic age or marble of Palaeozoic age in the floor of serpentinite. By means of ^3H (tritium) and carbon ^{14}C isotope, the estimated age of Mataruska Banja Spa waters amounts about $16\,700 \pm 350$ years.

The existence of the collector within the serpentinite and hydro thermally altered serpentinite has been stated while working the MB-1/79 (355m), MB-2/81 (130m) and MB-3/83 (733m) exploratory-abstraction wells on the territory of the Mataruska Banja Spa (Tab. 1). The fault zone in hydro thermally altered serpentinite along which the circulation of groundwater takes place was discovered by working the MB-1/79 drillhole in the interval of 6–56 m, while at the MB-2/81 drillhole that zone is caught by the whole interval to 130 m. The younger fault zone is not drilled by the MB-3/83 well, although its depth is 733m.

Table 1. General data on exploratory-abstraction wells on the territory of Mataruška Banja Spa.

Well	Well depth(m)	Groundwater table	Q (l/s)	S (m)	K (cm/s)	T (m ² /s)
MB-1/79	355	2.6	6.54	22.7	1.28×10^{-2}	5.29×10^{-3}
MB-2/81	130	2.34	21	2.7	5.69×10^{-2}	2.27×10^{-2}
MB-3/83	733	5.72	6	23.5	—	—

The thermo mineral water from the MB-2/81 well belongs to the category of sodium, magnesium, hydro carbonate, fluorine, sulphureous, hyper thermal water (Tab. 2).

Table 2. Comparative survey of chemical composition of Mataruška Banja Spa thermomineral water.

Well	Depth (m)	T (°C)	pH	M (mg/l)	Na ⁺ (mg/l)	Ca ²⁺ (mg/l)	Mg ²⁺ (mg/l)	HCO ₃ ⁻ (mg/l)	Cl ⁻ (mg/l)	SO ₄ ²⁻ (mg/l)	H ₂ S (mg/l)
MB-1/79	355	32	6.9	1466	188	45	85	952	71	10	0.12
MB-2/81	130	52	6.95	1293	221	14	46	730	6	112	19
MB-3/83	733	25	—	958	18	70	113	385	35	304	0.22

By a chemical analysis, significant quantities of H₂S of 19mg/l, were measured in thermo mineral water of the MB-2/81 well, which makes this water a healing one. Hydrogen sulphide in the thermo mineral water of the Mataruska Banja Spa is probably of igneous origin. The mineralization ranges from 1 to 1.5 g/l. The temperature scope is in the interval of 25–52°C. The temperature at the main well amounts 52°C and ,besides the increased concentration of H₂S, represents the main therapeutic value. The water is mildly radioactive.

The therapeutic effect of healing thermo mineral water of the Mataruska Banja Spa is realised best by bathing in hot sulphurous water and by muddy compresses. The increased temperature of 52°C, the concentration of hydrogen sulphide (to 19 mg/l) and the presence of meta silicon acid (about 100 mg/l) represent the basic balneologic properties of this water.

Rheumatic diseases, gynaecological diseases, post traumatic conditions and all their consequences, neurological diseases, damages of central and peripheral nervous system, as well as the diseases of peripheral blood vessels are cured in the Mataruska Banja Spa.



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