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RESOURCES AND HEALING PROPERTIES OF SULPHUR-HYDROGEN MINERAL WATERS OF SERBIA

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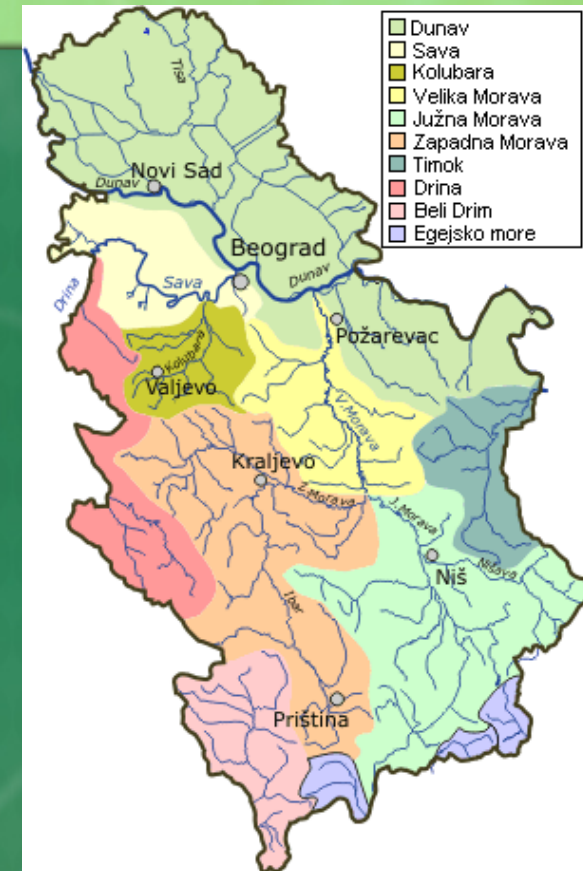
GEOGRAPHICAL SETTING



CLIMATIC AND HYDROLOGICAL CONDITIONS

- ❖ Climate of Serbia can be described as moderate-continental with more or less pronounced local characteristics.
- ❖ The altitudes within the study area range widely from 200m to 2600m
- ❖ In the mountain area, mean annual precipitations is over 1000 mm and in the plain parts the level of precipitations is amounts about 600mm
- ❖ Average annual air temperature up to 500m altitude of around 10.0°C and and over 1000 m of altitude around 6.0°C

The area of the investigated field generally belongs to the Black Sea watershed. All the waters in the investigated area gravitate to the main watershed of Danube River. Locally, the watershed of the Velika Morava River and Sava River is dominant.



Hydrological map of Republic of Serbia

THE MAIN GOALS OF RESEARCH

- ❖ Determination of sulphur-hydrogen mineral waters of Serbia
- ❖ Nowadays hydrogen-sulphide is being used intensively for healing purposes
- ❖ Monitoring of groundwater quality in wider study area
- ❖ Mapping of sulphur-hydrogen mineral waters

The results presented in this paper represent face one of the research mentioned above

THE APPLIED METHODOLOGY OF INVESTIGATION

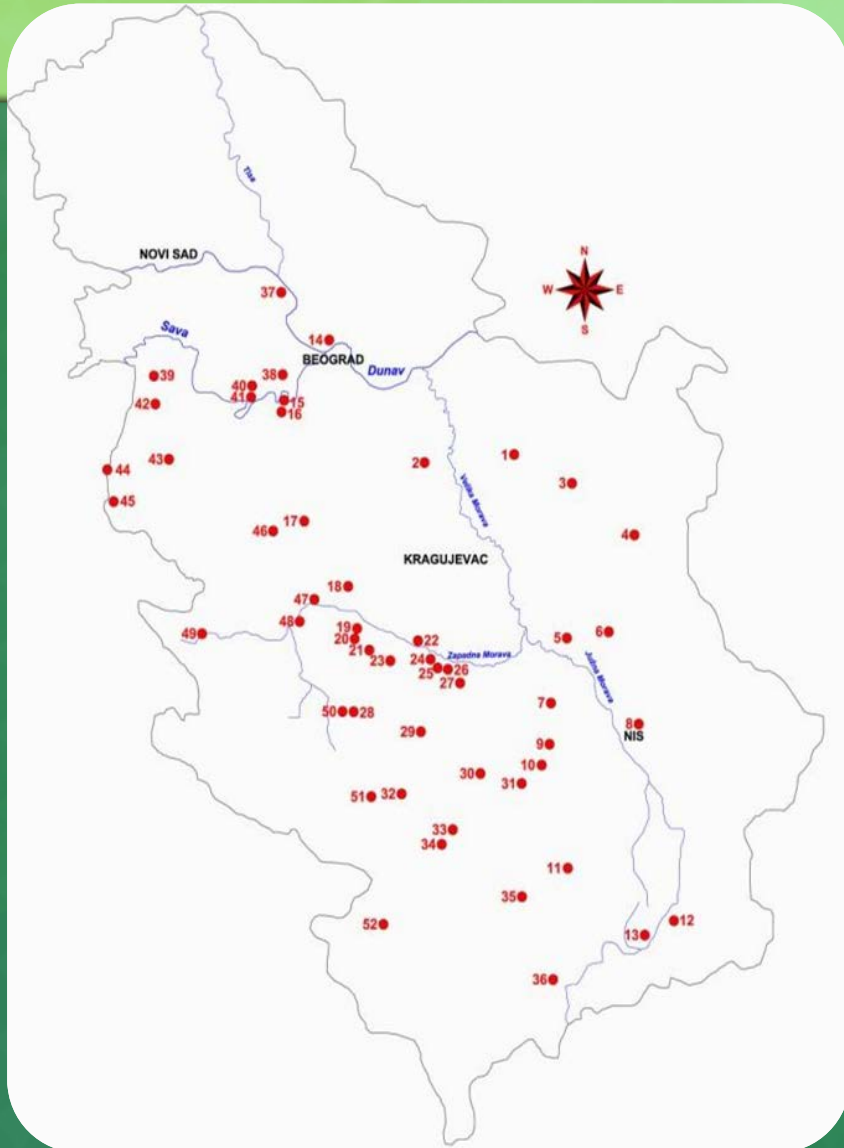
Methodological procedures which are generally divided into three groups:

- ❖ **Field investigations**
- ❖ **Laboratory investigations**
- ❖ **Study investigations**

ABOUT SULPHUR-HYDROGEN MINERAL WATERS

- ❖ Can occur in specific formations and gives the water a characteristic "rotten egg" taste or odor
- ❖ Hydrogen sulfide gas can result from a number of different sources
- ❖ The obtained data have pointed out that nowadays hydrogen-sulphide is being used intensively for healing purposes
- ❖ Recently for balneological purposes

SULPHUR-HYDROGEN MINERAL WATERS ON THE TERRITORY OF SERBIA

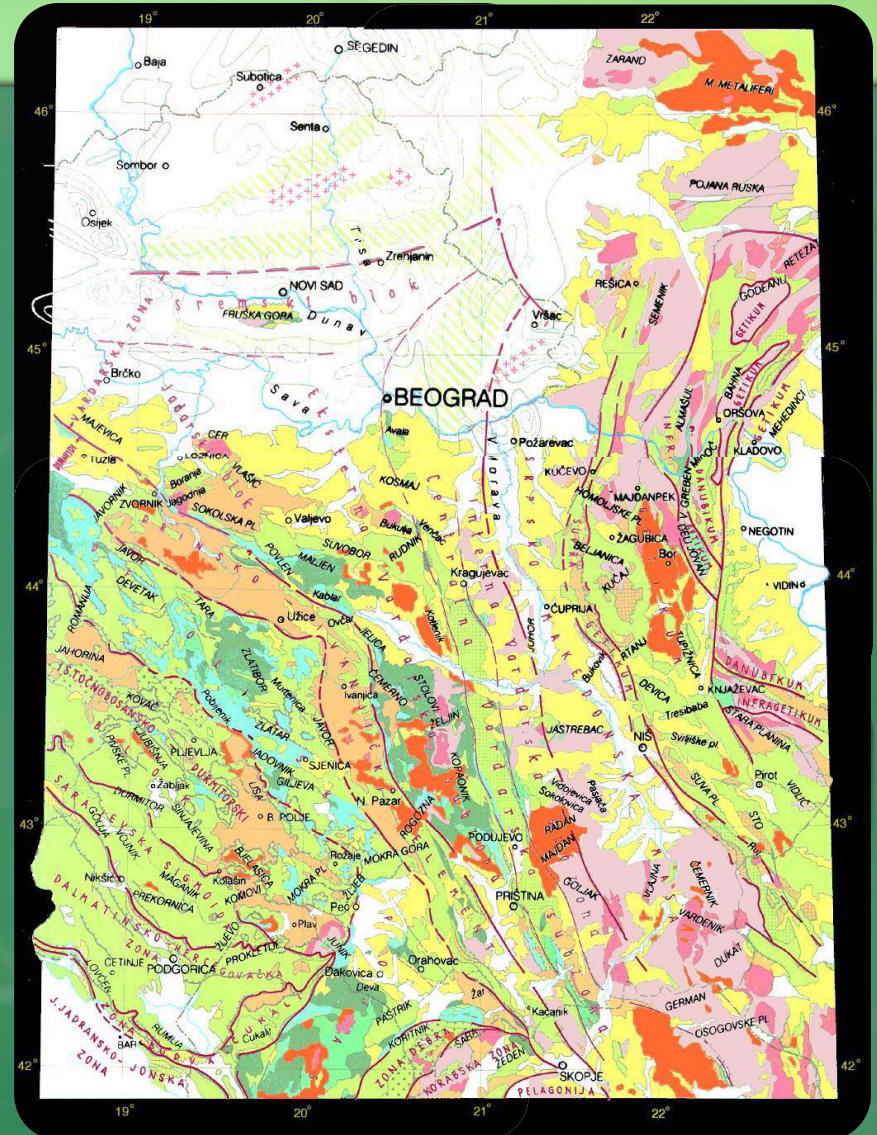
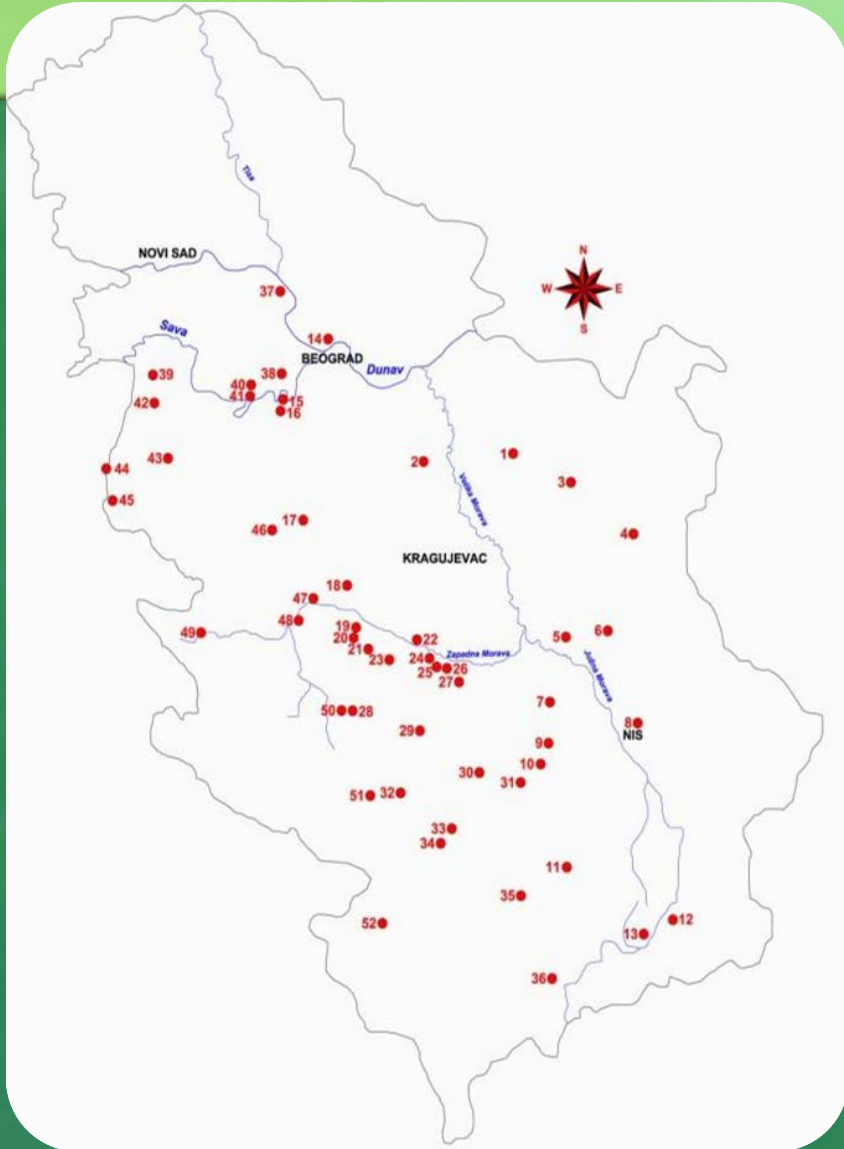


No	Location	No	Location
1	Malo Laole	27	Mivela-Veluce
2	Palanački kiseljak	28	Bogutovačka Banja
3	Suvi Do (Žagubica)	29	Jošanička Banja
4	Šarbanovačka banja	30	Lukovska Banja
5	Banja Jošanica	31	Kuršumlijska Banja
6	Lepteriја (Soko Banja)	32	Novopazarska Banja
7	Ribarska Banja	33	Banja Vuča
8	Kulinska Banja	34	Banjska
9	Suva Česma	35	Lužane
10	Pločnik-barutana	36	Klokot Banja
11	Tularska Banja	37	Slankamen
12	Vrnajska Banja	38	Jakovo
13	Bujanovačka Banja	39	Bogatić
14	Višnjčka Banja	40	Kupinovo (Tp)
15	Obrenovac "Kasarna"	41	Kupinovo (1/H)
16	Obrenovačka Banja	42	Dublje
17	Banja Ljig	43	Banja Badanja
18	Brđani	44	Banja Kovlijača
19	Žaočani	45	Radaljska Banja
20	Banja Slatina	46	Planinica
21	Mršinci	47	Ovčar Banja
22	Vitanovac	48	Kotraža
23	Mataruška Banja	49	Kremna
24	Vrnjačka Banja (Snežnik)	50	Lopatnička banja
25	Vrnjačka Banja (Slatina)	51	Rajčinovića Banja (t)
26	Vrnjačka Banja (Jezero)	52	Pečka banja

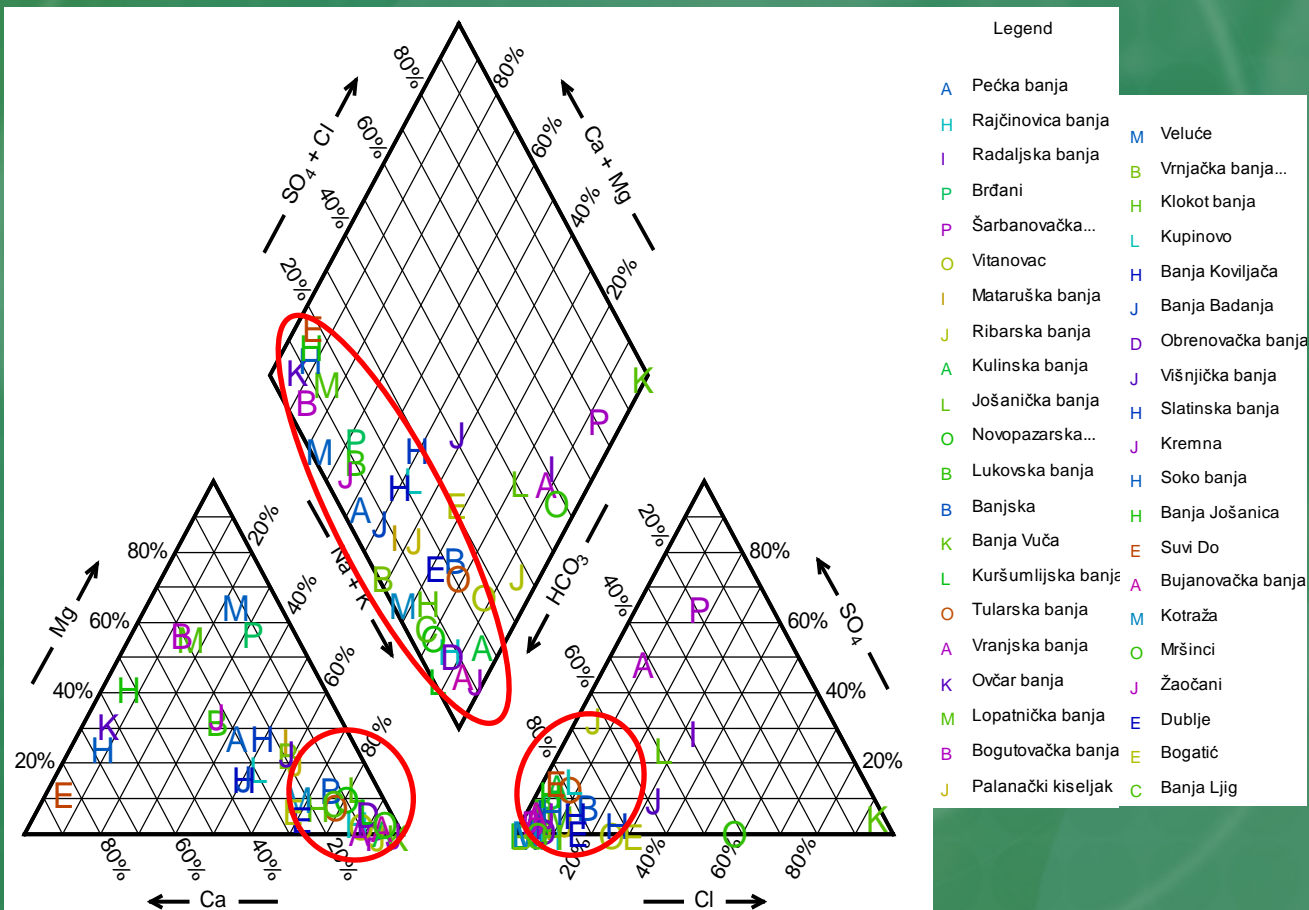
**MORE THAN 50
OCCURRENCES!**

GENERAL GEOLOGIC-HYDROGEOLOGIC FEATURES OF THE STUDY AREA

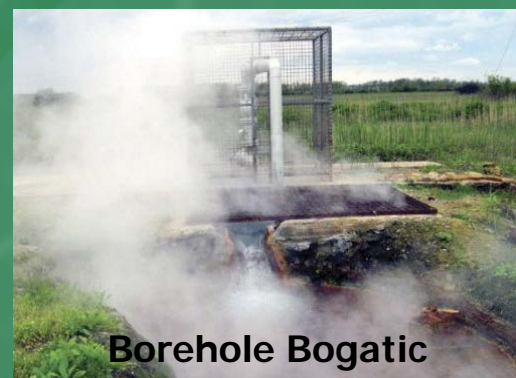
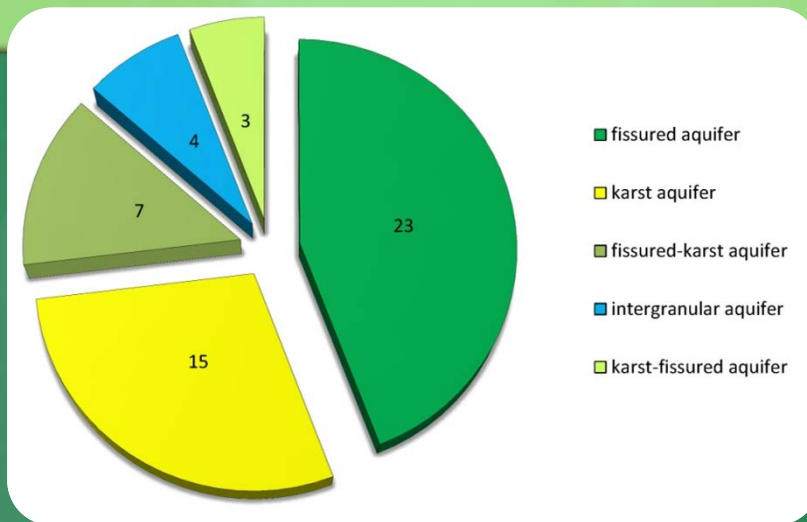
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PIPER TRILINEAR DIAGRAM OF SULPHUR-HYDROGEN MINERAL WATERS



SULPHUR-HYDROGEN MINERAL WATERS ON THE TERRITORY OF SERBIA



THE MOST IMPORTANT SPA IN SERBIA WITH SULPHUR-HYDROGEN IN GROUNDWATER

Vranjska Banja Spa

Ribarska Banja Spa

Mataruška Banja Spa

Jošanička Banja Spa

Novopazarska Banja Spa

T (°C)	H ₂ S (mg/l)	KURLOV FORMULA
84	0,70	$M_{1,3} \frac{HCO_{50}^3 SO_{42}^4 Cl_8}{Na + K_{94} Ca_6} Q > 60,0$
33,0	3,00	$M_{0,31} \frac{HCO_{47}^3 SO_{26}^4 CO_{19}^3}{Na + K_{\infty}} Q > 20,0$
52,0	14-19	$M_{1,39-1,48} \frac{HCO_{87}^3 Cl_{10}}{Na + K_{57} Mg_{26} Ca_{14}} Q > 10,0$
72,0	1,60	$M_{0,3} \frac{CO^3 + HCO_{70}^3 Cl_{16} SO_{10}^4}{Na + K_{49} Mg_{24} Ca_{24}} Q > 30,0$
54,5	9,50	$M_{1,72} \frac{HCO_{92}^3}{Na + K_{79} Mg_{10}} Q > 3,0$

USING SULPHUR-HYDROGEN IN GROUNDWATER FOR HEALING

Groundwaters rich in sulphide and hydrogen-sulphide are used in the healing of wide range of diseases, from skin infections, respiratory problems to skin inflamed processes.

- ❖ Joint and other kinds of rheumatism and sciatica,
- ❖ Skin diseases (especially psoriasis)
- ❖ Diseases of central nervous system
- ❖ Orthopaedic diseases
- ❖ Gynaecological diseases
- ❖ Problems with liver and gastro-intestinal tract,
- ❖ Respiratory problems,
- ❖ Arthritis problems,
- ❖ Post-traumatic and postoperative disorder,
- ❖ Detoxification of organism.

CONCLUSIONS

- ❖ More than 50 occurrences with sulphur-hydrogen in groundwater on the territory of Serbia
- ❖ Overall reserves of sulphur-hydrogen mineral waters on the territory of Serbia amount about 400 l/s.
- ❖ Using sulphur-hydrogen mineral waters for healing purposes.



THANKS FOR YOUR ATTENTION !!!

...questions, suggestions, comments...