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Hydrogeochemical Characteristics of the Suleymanli Thermomineral Waters, Kahramanmaras, Turkey

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The present study was carried out to assess the hydrogeochemical composition of the Suleymanli (Kahramanmaras, Turkey) thermomineral springs. The springs issue along fault zones and their temperatures ranks between 40 and 45 ºC and they are classified as hot water. Chemical analysis indicate a chemical composition of Mg > Ca > (Na + K) and HCO_3 > SO_4 > Cl. The results of chemical and heavy metal analysis are evaluated according to the World Health Organisation and Turkish Standards. As a conclusion, the Suleymanli hot waters can be drinkable and usable for health treatment.

Key Words: Suleymanli, Thermomineral water, Water quality parameters.

INTRODUCTION

Thermomineral resources are commonly utilized by human beings for treatment of several diseases in Turkey. In view of this, hydrogeochemical investigations were carried out in the North part of the Kahramanmaras area, to assess the quality of groundwater its suitability for medical purposes. The area under study is situated about 50 km from the city of Kahramanmaras, Turkey. The Kahramanmaras region has some thermomineral springs which are used for human health purposes in the spa areas of Dongel, Uyuzpinari and Suleymanli. Dongel spring remained under dam reservoir, Uyuzpinari is natural thermal springs but it has vey low discharge rate. The spring investigated in this paper is Suleymanli spring water are discharged from drilled wells. A study of the hydrogeochemistry of the waters includes determination of ionic concentrations of spring water and classification of water genetic groups.

The previous studies[1,2] were limited to general geology and tectonics of the thermal waters site. A few researcher studied hydrogeochemical characteristics[3-5] of the thermomineral waters in the Kahramanmaras district.

The study area is comprised of Mesozoic and Cenozoic lithologic units which they are (1) Mesozoic limestone, (2) Volcano-Sedimantary rocks Upper Cretaceous-Eocene in age, (3) Eocene conglomerate with blocks (4) Miocene aged conglomerate, sandstone, claystone, limestone, marl, resiphal limestone alternations and (5) Quaternary aged alluvium and talus.

Thermomineral waters in the study area issue along the thrust faults at 5 locations in 2 groups. The first spring group emmerges from 2 points but the spring waters put together in one place (called sample number S). The total discharge (average flow) is 2.2 L/s. The second group also discharges from 2 locations and they are assembled as same as first one (called sample number Z). The discharge rate is 0.8 L/s. On the other hand, there are one thermal water spring at the base of the creek but this spring has no discharges anymore.

EXPERIMENTAL

Thermomineral water samples were collected from the well and analyzed for various chemical parameters according to the American Public Health Association[6]. Detailed quality assurance practices were followed for collection of samples in field, measurement of field parameters and for the analysis of the samples in the laboratory. Some of the chemical and physical characteristics of the waters were measured in the field. Temperature measurements were done by means of thermometer, pH measurements by pH meter with 0.01 precision and electrical conductivity was measured by conductivity meter. The water samples were taken into capped 1,500 mL polyethylene bottles, acid (pure HNO_3) was added for cation analysis and unacidified for anions. The chemical analysis were carried out geochemistry laboratory at the Cukurova University (Adana) and Directorate of the State Hydraulic Works (DSI) (Kahramanmaras). Heavy metals were analysed by AAS. Sulphate contents were estimated spectrophotometrically along with alkalinity standard titrimetry. The anions which are chloride, carbonate and bicarbonate were detected by volumetric methods. The cations which are sodium and potassium were analyzed by flame photometer and calcium is determined by volumetric methods. Total dissolved solids and total hardness are computed.

RESULTS AND DISCUSSION

The results of physical and chemical analysis of the thermomineral water is summarized in Table-1. The pH values of thermal waters in the study area range from 7 to 8.5. Temperature ranges from 42 to 44 ºC, electrical conductivity values range from 390-530 µmho/cm. Total dissolved solids in the thermal water samples range from 316 to 446 mg/L and total hardness ranges from 178 to 254 mg/L.

TABLE-1
CHEMICAL AND PHYSICAL PROPERTIES OF SULEYMANLI HOT WATER

Sample No.	TDS	T (ºC)	pH	EC (µmho/cm)	K (mg/L)	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	HCO_3 (mg/L)	SO_4 (mg/L)	Cl (mg/L)
S1	395	43	7.5	465	1.3	14	48.0	24.5	260	32	15
S2	420	43	7.2	470	1.5	13	50.0	26.0	285	30	14
S3*	318	44	8.5	390	1.3	17	33.7	23.6	201	28	12
Z1	446	43	7.0	500	1.2	12	54.0	25.0	300	36	18
Z2	438	42	8.0	526	1.3	15	60.0	25.5	287	37	12
Z3*	317	44	8.2	420	1.1	15	34.5	22.4	201	30	14

*Reference 4.

Perusal of data given in Table-1, reveal that among the Ca^{2+} and Mg^{2+} are the dominating cation and HCO_3^- happens to be the dominating anion. The charge balance error was less than 5 %. The analytical ionic composition values of water samples is shown in the piper (Fig. 1) hydrochemical facies diagram and samples are grouped in zones 5. The waters are $CaCO_3$ waters in this area. These values are also plotted in the semi-logorithmic Schoeller diagrams (Fig. 2). The diagram indicates that the following abundance order for cations and anions as: Ca > Mg > (Na + K) and HCO_3 > SO_4 > Cl. And so, alkaline earth metals are significantly dominating over the alkalis, and weak acids dominate over the strong acids in the study area. The low sulphate content (< 50 mg/L) mainly indicates the deep geothermal waters[7] like in the study area.

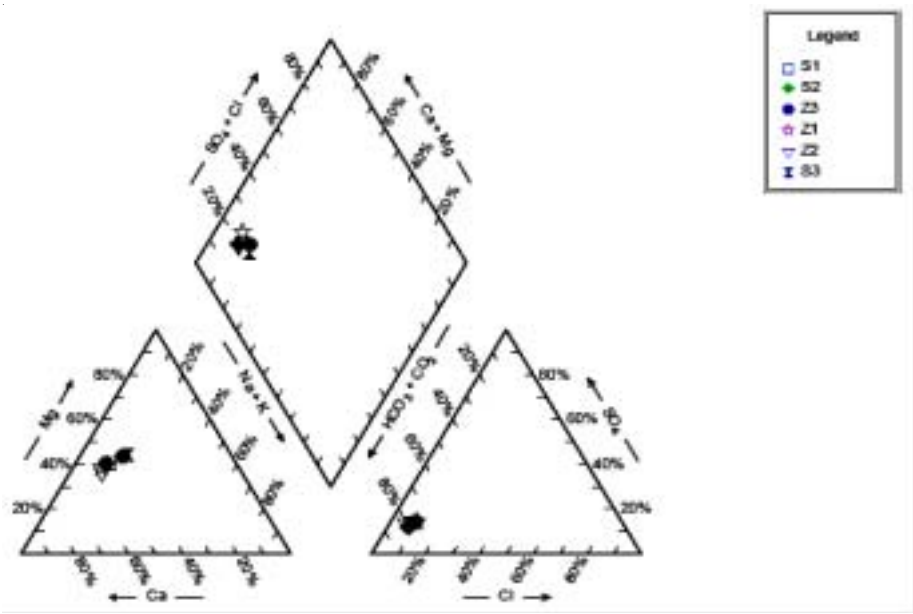

Fig. 1. Piper diagram

The results of heavy metal which are presented in Table-2 are evaluated as per the Environmental Regulations for Water Pollution Control[8].

The values of heavy metals indicates that all the thermomineal waters belongs to Quality Class I based on Zn, Cu, Al, Fe, Na, Cl, and SO_4, but Z group water samples belongs to Quality Class III based on Cu.

The thermomineral waters are commonly used for health treatment in Turkey but these waters can cause positive and adverse effects on human health. The Suleymanli springs are also used for treatment of stomach, rheumatism diseases as taking bath and drink. For this reason, the hydrochemical features of the Suleymanli thermal waters are compared with the limit values permitted by the Turkish Standarts[9] and World Health Organisation as shown in Table-3.

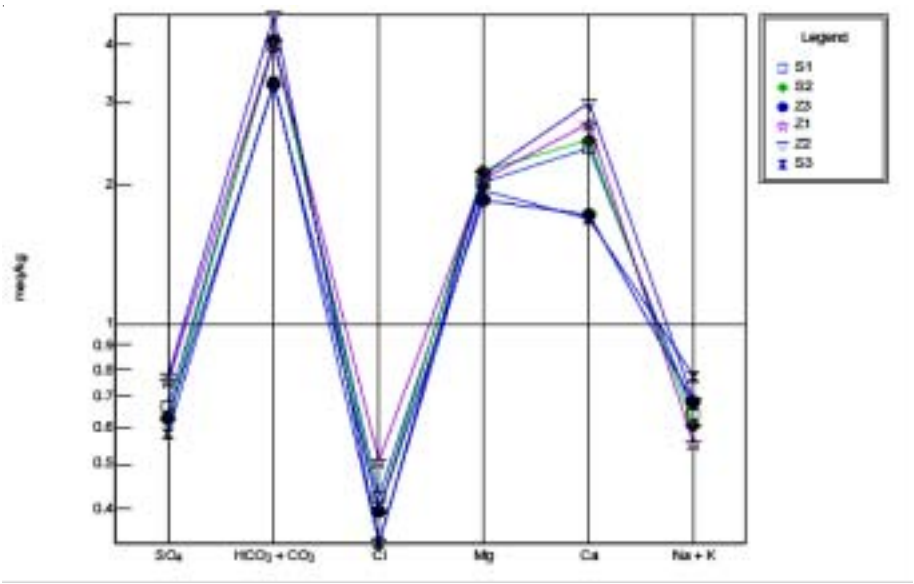

Fig. 2. Scholler diagram

TABLE-2
WATER QUALITY CLASSES OF SULEYMANLI HOT WATER

		Fe	Zn	Cu	Al	Na	SO_4	Cl
Quality class I		300	200	20	300	125000	200000	25000
Quality class II		1000	500	50	300	125000	200000	200000
Quality class III		5000	2000	200	1000	250000	400000	400000
Quality class IV		> 5000	> 2000	> 200	> 1000	> 250000	> 400000	> 400000
Sample S	(µg/L)	50	5	10	110	12000	32300	14800
	Quality class	I	I	I	I	I	I	I
Sample Z	(µg/L)	70	13	67	120	12000	36000	18000
	Quality class	I	I	III	I	I	I	I

TABLE-3
EVALUATION OF THE RESULTS ACCORDING TO THE TURKISH STANDARTS AND WORLD HEALTH ORGANISATION LIMIT VALUES

Ions	Drinking water		Mineral water (TS) (mg/L)	Sample group	
	WHO (mg/L)	TS (mg/L)		S	Z
Zn^{2+}	5-15	15	3	0.005	0.013
Cu^{2+}	0.05-1.50	1.50	1	0.010	0.067
Al^{3+}	-	-	-	0.110	0.120
Fe^{2+}	0.1-1.0	0.1-1.0	-	0.050	0.070
Na^{+}	200	200	-	12.000	12.000
SO_4^{2-}	200-400	200-400	-	32.300	36.000
Cl^{-}	200-600	200-600	-	14.800	18.000

Conclusion

The hydrochemical interpretations concluded that the following cations and anions arrangement: Ca > Mg > (Na + K) and HCO_3 > SO_4 > Cl. The high concentrations of Ca and HCO_3 in the waters are mainly indicated to carbonate rocks through the circulation in the surface and underground. In the study area, thermal waters are hosted by volcanosedimentary rocks. The waters are of meteoric origin and these water percolate to the depth and are heated by the geothermal gradient and then rise to the surface through a fault zone. Using the piper diagram, the waters are calcium, magnesium bicarbonate waters and they are grouped in the 5. region. On the basis of IAH classification waters are Ca-Mg-HCO_3-bearing thermal and mineral waters. According to the chemical and physical properties the Suleymanli thermomineral waters can be usable for health tourism.

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