ASSESSMENT RESERVOIR TEMPERATURE OF WEST GEORGIAN GEOTHERMAL DEPOSIT BYAPPLICATION OF SILICA-ENTHALPY MIXING METHOD

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Abstract. *This study to use geochemical techniques to evaluate geothermal reservoir in West Georgia. About Thirty thermal water samples were taken from existing thermal boreholes on the territory of West Georgia. The samples revealed the majority have Na-K-HCO3 composition compared to just some of them Na-K-Cl-SO4 and Ca-MgSO4-Cl. Water-type changes from Sulfate-Chloride to bicarbonate from the West to the East were also observed. Reservoir temperature estimations by silica-enthalpy method is 130 ºC, 163 ºC, 212 ºC.*

The results of this and other current studies manifest the need for further researches and the steps and methodology thereof.

Key words: *geochemistry, geothermal reservoir, geothermometers, silica-enthalpy mixing method.*

Introduction

The objective of this study is to investigate the geochemical characteristics of the thermal waters. For hydrogeochemical evaluation, the commonly used Durov and L-L diagrams approach has been used. In order to assess the maximum reservoir temperature, the silica-enthalpy mixing method was applied.

Field survey-sampling-analytical methods

All analyses were carried out at the chemical laboratory of the Research Center of Hydrogeophysics and Geothermy, M. Nodia Institute of Geophysics, Ivane Javakhishvili Tbilisi State University. Unstable hydrochemical parameters, including temperature, pH and electrical conductivity (EC) were measured with portable field laboratory WTW 197i which was calibrated in the field prior to every sampling. Physico-chemical data of the area were subjected to graphical treatment by plotting them in different diagrams using "Aquachem 5.1" software (Schlumberger water services) and graphing package "Grapher10" (Goldensofware) in order to better understand the hydrochemical processes in the study area.

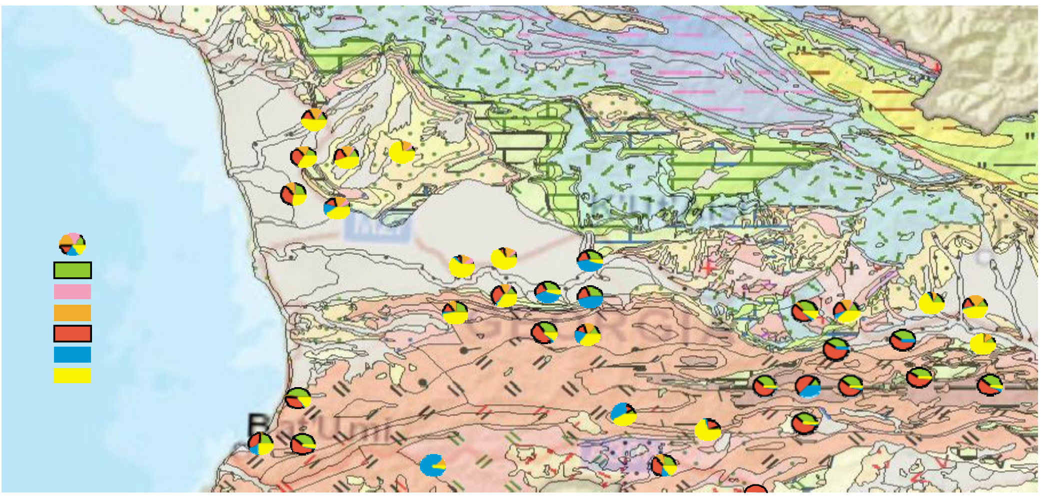

Fig. 1. Distribution of hydrochemical composition in boreholes on the territory of Georgia

Silica-enthalpy mixing method

Application of chemical composition silica geothermometers is a common practice to investigate the thermal state of geothermal reservoirs [4]. Geothermal water transfers heat to the contact rock while rising tothe surface and they have lower temperatures than the reservoir.

In order to investigate the thermal state of geothermal reservoirs the chemical geothermometers, as a standard tool, were applied. The data of chemical analyses of water collected from the thermal boreholes and the SiO_2 concentration in waters were used for subsurface temperature calculation by using silica-enthalpy mixing model.

The sample LR-01, having the minimum SiO_2 concentration and temperature, was used as the non- thermal component of the mixed waters. In Figure 2 possible a, b and c mixing lines were drawn. If we assume that maximum steam loss occurs before mixing, the three lines drawn from the cold-water component of the mixed water through the mixed thermal waters till the intersection with the vertical line drawn from the boiling (100 ºC) temperature - as a steam release temperature, will give 3 points A, C, E. And the intersections of drawn horizontal lines from these points to the quartz solubility curve (B, D and F) correspond to the maximum steam loss. The values of obtained points give the original silica concentrationof the thermal water component. The values are about 130 ºC, 163 ºC, 212 ºC.

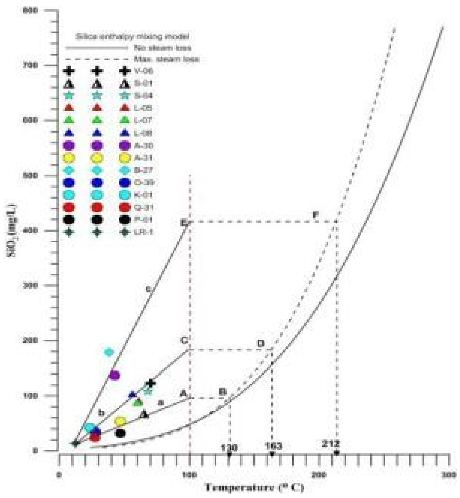

Fig. 2. Silica enthalpy mixing model (Truesdell and Fournier, 1977)

LR-1 represents the Legvtakhevi river sample, which is used for non-thermal component. Sample IDs correspond to all tables and Figures

Table 1. Distribution of temperature on the surface and in the depth of boreholes.

BoreholesN	Location	X	Y	Eleva taion	pH	Temper onthe surface	Temper in aquifer
TS-1	Green-house	42,470468	41,83253	59,3	7,48	87,5	192
TS-2	Tsaishi bor. 1	42,450018	41,809178	54,6	7,32	87,4	204
TS-3	Tsaishi bor. 8	42,451932	41,801215	33,0	7,34	95	194
TS-18	Tsaishi bor. 18				7,18	92,6	198
KH-1	Khobi, bor. Green-house	41,912864	42,317098				158
AR01	Makhinjauri bor.	41,703661	41,669386	32,0	8,84	36,6	81
AR02	Kobuleti bor, with oil	41,798521	41,821065	27,4	8,4	35,7	59
RR01	Buturauli bor.	42,246238	41,624797	596,0	8,2	20,4	50
GU28	Qveda Dzimiti bor.	42,051158	41,981795	45,7	8,75	25,4	
GU37	Sachamias-Seri	42,299368	42,040352	75,2	9,957	26	
JA14	Abastumani bor. Samefo abano	42,838219	41,744829	1268	9,45	37,1	101

IM41	Sulori bor.	42,580505	42,034134	193	9,95	37,3	116
IM164	Amagleba bor 1	42,626776	42,094409	65,7	6,5	35,7	92
IM170	Amagleba bor 2	42,627114	42,095929	65,9	6,4	40,5	99
IM171	Dikhashkho bor.	42,576016	42,089551	51,8	6,5	35,9	105
IM172	Chgan-Chgvishi bor	42,411268	42,126458	28,3	6,769	48,4	99
IM177	Tsikhesulori bor	42,472566	42,112028	31,5	6,64	54,4	100
IM173	Vani bor	42,517604	42,09255	50,9	7,3	32,5	
IM173	Dikhashkho bor.	42,586878	42,104496	57,2	6,3	41,1	98

The increase of temperature amount in the aquifer depends on the depth of the boreholes and the thermalproperties of the rocks crossing by the boreholes.

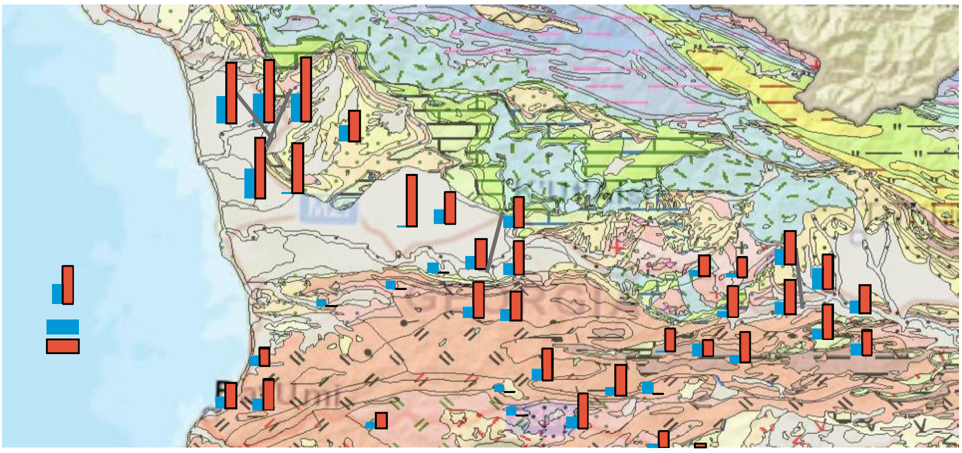

Fig. 3. Distribution of temperature in Georgian boreholes
Blue column - well water temperature at the wellhead, red column - water temperature in the aquifer

Conclusions:

Deep thermal water migrating upward mixes with shallow groundwater system and changes its chemical properties. Thermal waters have mainly Na (K)-HCO_3, Na (K)-Cl-SO_4 and Ca (Mg)-Cl-SO_4 composition. The reservoir temperatures according to silica-enthalpy method give the values about 130 ºC, 163 ºC, 212 ºC, that should be corrected by application of silica and cations' geothermometers.

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Acknowledgments: **The authors thank the Rustaveli National Scientific foundation for financial support of the project FR-18-19173 "Study of geothermal potential of Georgia by hydrogeochemical and isotope methods".**