PROCEEDINGS, Twenty-Third Workshop on Geothermal Reservoir Engineering
Stanford University, Stanford, California, January 26-28, 1998
SGP-TR-158

A Chemical Caracterization of Geothermal Waters from West Field of Romania. I. Geothermal Waters from Oradea.

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ABSTRACT

Chemical characterization of geothermal waters of Triassic Collector from region Oradea is presented here. Both the constituent like (Cl^-, NO_2^-, NO_3^-, HCO_3^-, CO_3^{2-}, SO_4^{2-}, PO_4^{3-}, Ca^{2+}, Mg^{2+}, Na^+, K^+ etc) and microelements were found in these waters using various methods. On the basis of these facts those cab be classified in category of sulfate - bicarbonate - calcium -magnezic waters.

INTRODUCTION

The geothermal waters in the Western Field of Romania are cantonated in geological formations of different ages. In order to know these waters it's very important to make the researche from a Chemical point of view out of which we can draw several important conclusions not only concerning some aspects regarding their origin for establishing some preferential direction for flowing.

The geothermal aquifer system from Oradea where waters are cantonated in the Triassic collector has been studied especially by the use of hydrological drilling s in the area of the tectonic sinking. A special interest in that of the dolomite calcareous complex which present advantageous conditions for the accumulation of waters at a depth between 2000 - 3000 m [1[. The geothermal system have at the head of the probe a temperature between 67 - 101°C and debits between 6 - 40 l/s at a free flow. The flowing direction of these waters is E - A' being intuited on geological bases of a result of the presence of carstic phenomen in the area of the mountains. which absorbs great

quantities of meteoric waters. There is also a direction for flowing orientated approximately towards NNW - **SSE,** both direction leading to Oradea

The present work presents the obtained from the reseach made from a chemical point view of the following geothermal waters source from Oradea which belongs to the Triassic Collector: 4004 (Brăteanu **Park).** 4005 (Hothouse), 4006 (Municipal Swimming). 4081 (Nufăru I District): 4767 (Sports Hall). 3795 (Nursery). 3796 (University). 4797 (Nufăru II District). 1715 (Velenţa District). 1716 (Airport). 1717 (North Iosia City), 1022 (Sânandrei City, 4019 Palota City). and 501 (Livada City). Since they have similar characteristics and belong to the some Triassic collector it is also presented the following water sources which however do not belong to the area of Oradea: 4008 (Cotiglet). natural spring from Răbăgani and Daniela spring from the Toplita river bed from Lunca Sprie.

METHODS OF WORK

To estabilish the content of the major elements of the geothermal waters studied it has been determined the following: the pH (with pH-meter MV-85), the conductivity (with Radelkis conductometer). the total residue (to be obtained during evaporation of 100 cm3 waters at 105°C), the oxidable organic compouds (permanganate method), the harness of water (complexometric titration with EDTA) [2[. the solubl silicate (colorimetric determination as silicomelibdenic acid) [3], the phenols (colorimetric determination with diazotization sulfanilic acid) [2]. the nitrat ion (colorimetric determination with phenyldisulfonic acid in ammonium hydroxide medium) [3], the nitrite ion (colorimetric determination as *azo* compound of β-naphtol), the carbonate and the bicarbonate ions (acid titration) [2]. the sulfate ion (gravimetric determination as barium sulfate]. the phosphate ion (colorimetric determination as ammonium phosphowolframate) [3]. the ammonium ion (colorimetric determination uith Nessle reaction), the natrium and the kalium ions (with phlaniphotometer Phlapho-4). the calcium and the magnesium ions (complexometric titration) and the iron ion (colorimetric determination with o-phenantrolyne).

The microelemnts were determinated from the residue by evaporate through gamma spectroscpy and emission spectroscopy.

The probes were harvesting at head of the well and transported in the laboratory. The analyses had

been done during **8** years every **3** months. The results represent an avarage of the obtained values.

RESULTS AND DISSCUTIONS

The results of the analysis are presented in the 1 - **3** th. tables.

The table number **4** represents the percentage of composition calculated from the ionic content of the studied water which is repressed in meq/l, belonging to the aquifer system of the Triassic.

The waters generally are sulfate - bicarbonate - calcium - magnesic. Individually we can say the following:

- water from drilling 1715 (Velenţa District) belongs to the category of waters intensely (strongly.s) sulfate. law (l) bicarbonate. intensly calcium and law magnesium ($S^sC^lCa^sMg^l$);
- nater from drilling 1716 (Airport) belongs to the category of waters intensely (strongly) sulfate. law (l) bicarbonate. intensly calcium and law magnesium ($S^sC^lCa^sMg^l$):
- water from drilling 1717 (North Iosia City) is water intensely sulfate. low bicarbonate, intensely calcium and low magnesium ($S^sC^lCa^sMg^l$):
- water from drilling 4004 (Brătianu Park)) is a water having intense content of sulfate and calcium ions and low content bicarbonate and magnesium ions. ($S^sC^lCa^sMg^l$);
- water from drilling 4005 (Hothouse) is a water with on intensely content of sulfate and calcium ions and low content bicarbonate and magnesium ions, ($S^sC^lCa^sMg^l$);
- water from drilling 4006 (Municipal Swimming) is a water with on intensely content of sulfate and calcium ions and low content bicarbonate and magnesium ions. ($S^sC^lCa^sMg^l$);
- water from drilling 3081 (Nufăru I District) is on water very intensely (vs) content of sulfate ion, intensely calcium ion and low content magnesium ion. ($S^{vs}Ca^sMg^l$):
-- water from drilling 4767 (Sports Hall) is on water intensely content sulfate and calcium ions and low content bicarbonate and magnesium ions. ($S^sC^lCa^sMg^l$):
-- water from drilling 4795 (Nursery) is on water intensel? content sulfate and calcium ions and low content bicarbonate and magnesium ions. ($S^sC^lCa^sMg^l$):
-- water from drilling 4796 (University) is on water intense]\ content sulfate and calcium ions low content bicarbonate and magnesium ions. ($S^sC^lCa^sMg^l$):
- water from drilling 4793 (Nufăru II District) is on water intensely content sulfats ion. low content

bicarbonate ion and intensely content calcium ion. ($S^sC^iCa^s$);

- water from drilling 4008 (Cotiglet) is intensely content sulfate ion, low content bicarbonate ion and moderate (m) content calcium and magnesium ions, ($S^sC^lCa^mMg^m$);

- water from natural sources Răbăgani is intensely content bicarbonate ion, law content sulfate ion. moderat content magnesium and calcium ions. ($C^iS^lCa^mMg^m$);

- water from natural spring Daniela is very intensely (vs) content bicarbonate ion and intensely content calcium ion. ($C^{vs}Ca^i$).

CONCLUZIONS

Acording to the I - IV tables ve con observe a big similarity concerning the composition of the studied waters. a fact that indicates for sure a common origin. consequently a total resupplied of the deposits. The mineralisation maintains in the intend 1000 - 1300 mg l. From these values abbots only the Răbăgani and Daniela sources which are not situated directly in the own collection of cantonation. It can be observed the presence of the soluble silicium in concentration domaine large enough being directly connected with the temperature of water. We can also see the absence from the collection of boric acid and phenols, fact that limitates the contact posibility of the geothermal waters from the studied zone with hydrocarbures or volcanic formations.

Concerning the ionic composition with no reception. all the sources have a larger content a sulfate (500 - 800 mg/l) moderate or weak bicarbonate (100 - 250 mg/l) and high of calcium and magnesium. ***As*** it can be in the tables the content of chlorines and natrum ions.

Following the microelements composition as the geothermal waters from the Triassic collection this abundance surprises is as we can see in the V-th table.

Also there have been identified through gatnma spectroscopy. in traces in the waters of this collection. following microelements. scandium. chromium. strontium. silver. indiu. cesiu. barium. praseodynium, europium. holmium. tantalum, platinum. gold. mercury and bismuth.

The general characteristic of the geothermal waters from the Oradea areea. constated in the Triassic collection. consiste in a comprised betwen 1000 and 1300 mg/l being predominated by sulfate and bicarbonate anions and calcium and magnesium cations.

REFERENCES
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3. J. Rodier "L'analyse de L'eau" Ed. Dumond. 1975.

TABLE No. I

The chemical characterization of geothermal waters from Oradea area

sources	pH	cond.	total residue	minera-lisation	harness	oxyd. organic comp.	SiO_2
		[µS/cm]	[mg/l]	[mg/l]	[°Ger]	[mg/l] $KMnO_4$	[mg/l]
1715	7.20	1400	223	799,10	32,90	15,17	37,00
1716	6.30	1650	1084	1178,03	41,30	29.41	61.19
gani							
Daniela	7.28	388	260	442.10	14.39	**4.56**	14.69

TABLE No 11.

The distribution in anion of geothermal waters from Oradea area

sources	$[Cl^-]$		$[HCO_3^-]$		$[SO_4^{2-}]$		total
1716	35.46	1.000	178,31	2,923	608,60	12,679	16.602
4081	17,63	0,497	144,28	2,365	823,82	17.163	20.025
4767	23.57	0,664	255,40	4.006	452.83	9,434	14.104
gani							
Daniela	3,54	0,100	305,40	5,006	11,67	0,243	5.359

*nitrate were found in the next sources: 4006 (0.36 mg/l) and Daniela drink:

** nitrate, carbonate and phosphate ions, boric acid and phenols were not found in determinate probes.

TABLE No. III

The distribution in cations of geothermal waters from Oradea area

sources		$[NH_4^-]$	$[Na^+]$	$[K^+]$	$[Ca^{2+}]$	$[Mg^{2+}]$	$[Fe^{2+}]$	total
1715	(mg/l)	0,95	5,00	a	161,92	44,62	0,78	
	(meq/l)	0,053	0,217	-	8,080	3,669	0,028	12,019
1716	(mg/l)	0,41	45,00	10,00	218,43	48,81	10,72	
	(meq/l)	0,023	1,959	0,256	10,900	4,013	0,284	17,432
1717	(mg/l)	0,65	52,00	12,00	250,50	42,56	1,15	
	(meq/l)	0,036	2,391	0,307	12,500	3,500	0,041	18,775
4004	(mg/l)	1,60	39,00	7,20	204,00	39,52	1,25	
	(meq/l)	0,089	1,696	0,184	10,180	3,250	0,045	15,444
4005	(mg/l)	2,01	21,00	12.00	244,69	50,71	0,46	
	(meq/l)	0,112	0,913	0,307	12,210	4,170	0,016	17,728
4006	(mg/l)	2,23	34,30	10,00	223,45	43,29	1,11	
	(meq/l)	0,124	1,491	0,256	11,160	3,560	0,039	16,620
4081	(mg/l)	1,99	18,00	11,00	250,40	73,19	0,78	
	(meq/l)	0,111	0,783	0,281	12,459	6,019	0,028	19,717
4767	(mg/l)	3,59	43,00	15,30	140,28	51,68	3,47	
	(meq/l)	0,198	1,869	0,391	7,000	4,250	0,140	13,848
4795	(mg/l)	0,37	95,00	10,00	194,19	25,05	2,50	
	(meq/l)	0,020	4,130	0,256	9,290	2,060	0,090	15,846
4796	(mg/l)	1,61	30,00	14,00	245,08	42,21	10,20	
	(meq/l)	0,089	1,304	0,358	12,229	3,471	0,365	17,816
4797	(mg/l)	0,65	45,00	15,00	191,58	26,93	2,70	
	(meq/l)	0,036	1,950	0,384	9,560	2,215	0,094	14,239
4008	(mg/l)	0,99	97,00	15,00	151,11	61,53	1,24	
	(meq/l)	0,055	4,217	0,384	7,450	5,060	0,042	17,298
Răbă-gani	(mg/l)	0,55	18,00	2,00	70,24	37,63	0,09	
	(meq/l)	0,030	0,783	0,051	3,504	3,095	0,003	7,466
Daniela	(mg/l)	2,91	1,80	4,50	90,58	7,53	0,48	
	(meq/l)	0,160	0,030	0,115	4,520	0,619	0,020	5,474

TABLE No. IV

The procentage distribution in major ions of geothermal waters

Sources	Cl^- (%meq)	HCO_3^{2-} (%meq)	SO_4^{2-} (%meq)	$Na^+ + K^+$ (%meq)	Ca^{2+} (%meq)	Mg^{2+} (%meq)
1715	5,94	13,01	31,03	0,46	33.61	15,26
1716	3,01	8.80	38,18	6,34	31,26	11.51
1717	5.40	6,03	38.56	7,18	33,29	9,32
4004	1,94	11,86	36,21	6,08	32,96	11,33
4005	0,00	7.94	42,06	3.44	34.44	11.76
4006	2,76	11,72	35,51	5,25	33,54	10,71
4081	1,24	5,90	52.80	2,70	31,68	15,26
4767	3,35	14,10	33,44	8,16	25,27	14,37
4795	1,30	14,21	34,49	13.83	29,31	6,50
4796	1,88	9,91	37,09	8,09	33,57	7.78
4797	1.05	11,86	37.07	13.32	21,83	14,65
Răbăgani	0,47	45,27	4,25	6,19	33.47	20.73
Daniela	0,93	46.79	2,27	1.32	41,28	5.65

TABLE No. V

The distribution of microelements in geothermal waters

Sources	V (x 10^3 mg l)	Co (x 10^4 mg l)	Ni (x 10^3 mg l)	Mn (x 10^3 mg l)
1715	4,50	-	0,12	1,10
1716	3,60	-	2,00	6,70
1717	4,40	9,00	41.00	24.00
4004	2,10	-	4.50	5,20
4005	3,50	-	1,80	6.90
3004	5.40	-	0.11	3.30
4081	4.80	-	-	1,30
1767	4.20	8,90	38.00	26.00
4795	3,80	3,50	1.60	7.10
4796	8.80	-	8,50	4.60
4797	5,10	-	-	1.50