25-29th September 2016 Montpellier, France CORUM CONFERENCE CENTER 43rd IAH congress

Medical Hydrogeochemistry of Iraqi Sulfurous Springs

Prof. Dr. Salih M. Awadh*

Abstract n°1575

1. Introduction

Hydrostatic pressure has effects mainly on cardiovascular and urinary systems; central blood redistribution. Buoyancy enables having easily lying position and ability to float and causes mechanical relaxation. Viscosity affects resistance of motion through water. Water immersion: pain – muscle spasms, increased metabolites. All these factors depend on many physico-chemical parameters shown in Table 2. So, sixteen springs in the Western Desert of Iraq were investigated and assessed for medical purposes.

Fig 1: View of spring (8H) in table 1.

2. Objective:

Due to the health effects which are:

- **Thermal:** Analgesic, Muscle relaxation, Anti-Inflammatory.
- **Mechanical:** Hydrostatic pressure, Buoyancy and Viscosity.
- **Chemical:** Absorption of trace elements.

This study aims to Assess the spring water for the medical uses (Spa)

3. Results:

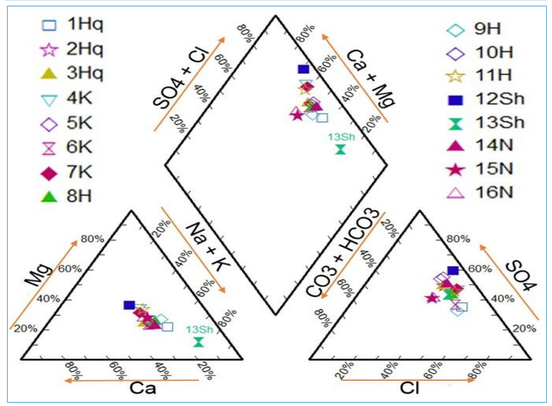

Fig 2: Piper diagram displays the spring water chemo-facies

Table 1: Dominant ions in the spring waters

S.no	Type		Family	Group
	Anions	Cations		
1Hq	$rCl>SO_4>HCO_3$	rNa>Ca>Mg>K	Na- Cl_4	Cl
2Hq	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na-SO_4	SO_4
3Hq	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na-SO_4	SO_4
4K	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na- SO_4	SO_4
5K	$rSO_4>Cl>HCO_3$	rNa>Mg>Ca>K	Na- SO_4	SO_4
6K	$rCl>SO_4>HCO_3$	rNa>Ca>Mg>K	Na- Cl	Cl
7K	$rSO_4>Cl>HCO_3$	rNa>Mg>Ca>K	Na- SO_4	SO_4
8H	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na- SO_4	SO_4
9H	$rCl>SO_4>HCO_3$	rNa>Ma>Ca>K	Na- Cl	Cl
10H	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na- SO_4	SO_4
11H	$rSO_4>Cl>HCO_3$	rMg>Ca>Na>K	Mg- SO_4	SO_4
12Sh	$rSO_4>Cl>HCO_3$	rNa>Mg>Ca>K	Na- SO_4	SO_4
13Sh	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na- SO_4	SO_4
14N	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na- SO_4	SO_4
15N	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na-SO_4	SO_4
16N	$rSO_4>Cl>HCO_3$	rNa>Ca>Mg>K	Na- SO_4	SO_4

Table 2: Parameters compared to the *European Union, 2009 and US spas (Lund, 1996 and Eaton, 2004)*; S=suitable for balneology; X=exceed limited

Indications		1Hq	2Hq	3Hq	4K	5K	6K	7K	8H	9H	10H	11H	12Sh	13Sh	14N	15N	16N
TDS	>1500	S	S	S	S	S	S	S	S	S	S	S	S	S	S	X	S
EC	>2310	S	S	S	S	S	S	S	S	S	S	S	S	S	S	X	S
Ca^{2+}	>150	S	S	S	S	S	S	S	S	S	S	S	S	S	S	X	S
Mg^{2+}	>50	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Na^{+}	>200	S	S	S	S	S	S	S	S	S	S	S	S	S	S	X	S
K^{+}	0-90	S	S	S	S	S	S	S	S	X	X	S	S	S	S	S	S
SO_4^{2-}	>200	S	S	S	S	S	S	S	S	S	S	S	S	X	S	S	S
Cl^{-}	0-1300	S	S	S	S	S	X	X	X	X	X	X	S	S	S	S	S
HCO_3^{-}	0-700	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
F	>1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Pb	<4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Zn	<5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Cd	$3x10^{-6}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Fe	0.023	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Mn	0.023	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Cu	$5x10^{-6}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Br	9.7	S	S	S	S	X	X	X	X	X	X	X	S	S	S	S	S
F	>1	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Sr	5.3	S	S	S	S	S	S	S	X	X	X	X	S	S	X	X	X
Al	0.02	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
As	$6x10^{3}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Cr	$35x10^{-5}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Hg	$7x10^{-6}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Se	$3x10^{-5}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Pb	<4	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Zn	<5	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Cd	$3x10^{-6}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Fe*	0.023	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Mn	0.023	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S
Cu	$5x10^{-6}$	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S	S

4. Conclusions:

- **pH** is slightly alkaline; **EC and TDS**; Excessively Mineralized Water; **Temperature:** Tepid Springs: (25- 34°C);
- **Hydrochemiacl facies: Family** (sodium – sulfate, sodium – chloride); **group** (sulfate and chloride).
- **Physicochemical parameters:** Mostly are suitable (see Table 2).
- **Trace elements:** Suitable

Consequently, Iraqi sulfurous springs can be considered as medicinal sites, could go towards establishing an international health tourism in terms of balneology.

5. References

- Eaton, J.2004: *Balneotherapy, hydrotherapy–therapeutic study*. The healing properties of the Tecopa hot spring manual water.
- http:// www.delightshotspringsresort,balneotherapy.html.
- Lund, J. 1996: *Balneological use of thermal and mineral waters*, vol25, No. 1. Elsevier Science, Great Britain, 103–147.

* **Dept. of Geology, College of Science, University of Baghdad, Baghdad, Iraq; E-mail: salihauad2000@yahoo.com**