Journal of Natural Sciences Research www.iiste.org
ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.5, No.7, 2015

Origin of Springs at Najaf Area .South Western of Iraq

S.A.J.M., AL-Dahaan
University of Kufa, Remote Sensing Center
E-mail : dr_saadialdahaan@yahoo.com

Abstract
Study area of spring's water is located at south western of Iraq in the Najaf city government between latitude (31º 00¯ – 32º 15¯) and longitude (43º 30¯ – 44º 30¯). The hydrogeology of area is explained two layers of groundwater. The first is resent deposits and the second is Miocene deposits. The second layer is important because of containment a big quantity of groundwater. Results show the classification for spring's water according to total dissolved solids (TDS) is slightly water to slightly brackish water and it was very hard according to total hardness.Also the results show the predominant salt is Magnesium Sulfate ($MgSO_4$) and sodium chloride (NaCl) according to hypothetical salts in spring's water. The water type is sulfate according to predominate of ions in springs. Most of spring's water (70%) is Calcium Chloride ($CaCl_2$) of marine water origin, while the minority (30%) is Sodium Sulfate (Na_2SO_4) of continental origin.

Introduction :

-Spring: It is aggregated groundwater emerges above the surface of the earth in the form of a stream of running water. Study area is a part of south western of Iraq in Najaf city governorate between latitude (31º 00¯ – 32º 15¯) and longitude (43º 30¯ – 44º 30¯) (Fig.1).

It represents part of south western desert. Najaf springs are a part of springs series, which is extend from Hit city in the west of Iraq to Samawa city in the south western of Iraq. They are nearly parallel to Euphrates River and take a shape eastern edge for western desert. The general direction for spring's distribution is mach with general direction of Iraqi faults at northwest – southeast (Budy.1987).

Springs are playing an important role in livelihood for per organisms by supplying water for different purposes. The speedy population growth in the last contracts all over the globe resulted in use additional of groundwater.

Springs water is wining more increasing value in water supply at dry region when surface water is very rare or faraway. Population growth, agricultural development and climate changing leads to more utilization for water resources (Boyed2000).

All over world, the descend in water level and quality of groundwater is explain consume for resources more than expected plus effects by civilized, industry and irrigation of groundwater. Pollution of groundwater will be a big problem which requires quick warning for environmental hazards effects on general human health.

Quantity of spring's water is high within rain seasons and ice melting and low through dry seasons. Spring is consisting by permeable layer containing water over impermeable layer then, the infiltrated water will flow towards water table unto cut across earth surface, crack, fault, geological structure, or change in soil permeability to form spring. It is essential resources for human populations especially with absent of surface water and no wonder, that arise civilizations or cities near springs.

- Springs are classified according to :
  1- Quantity of total dissolved salts (TDS): - Fresh springs. - Minerals spring.
  2-According to water temperature: - Warm. – Hot. - Very hot springs.
  3-Based on the flow of water: - Intermittent. – Permanent. –Periodical springs.
  4-The Source composition: - Artesian springs. - Gravity springs.
  5-Shape of spring's slot: - Infiltration springs. - Joints and fractures springs.
  (Todd.2007) (Al-Fatlawi.2010).
- Study Aims to Find Out:
  1- The hydrogeochemical of spring's water.
  2- The relationship between the origin and source of the springs and general geological structure in the study area.

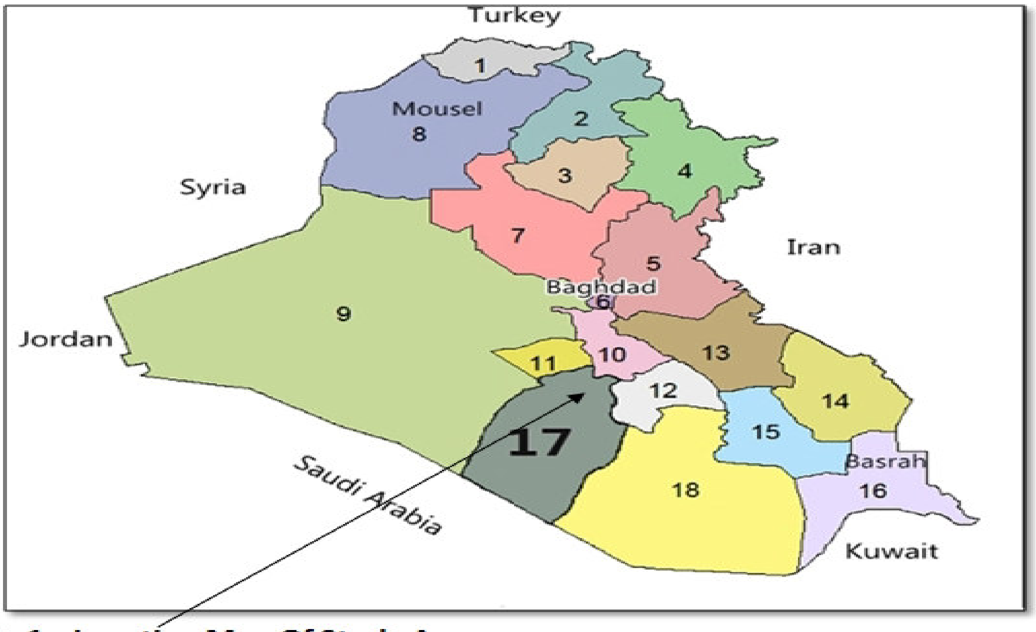

Fig.1 : Location Map Of Study Area.

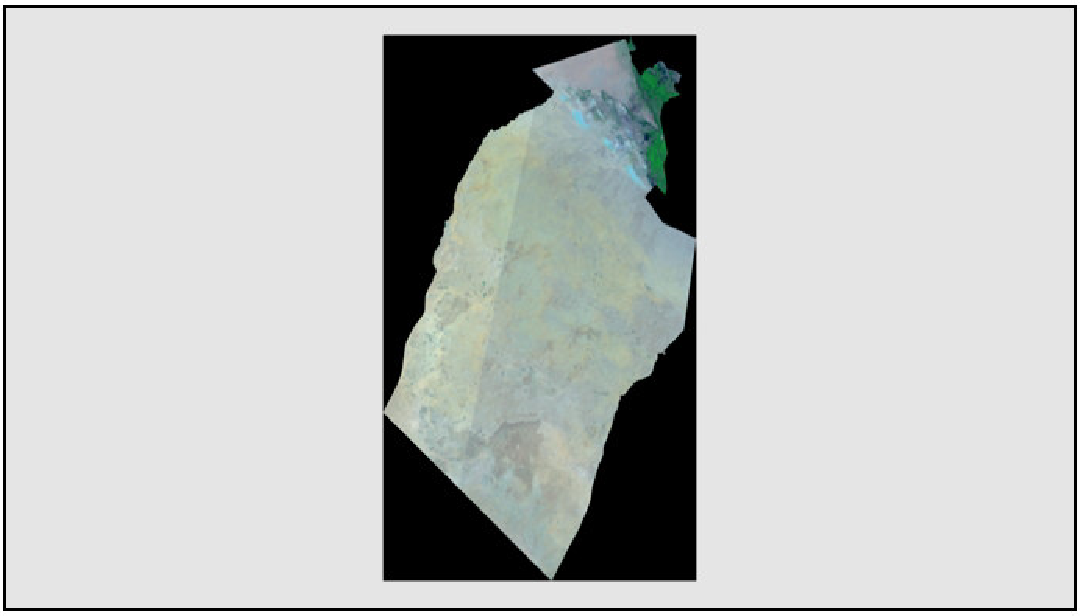

Fig . 1 . A : Space picture for study area.

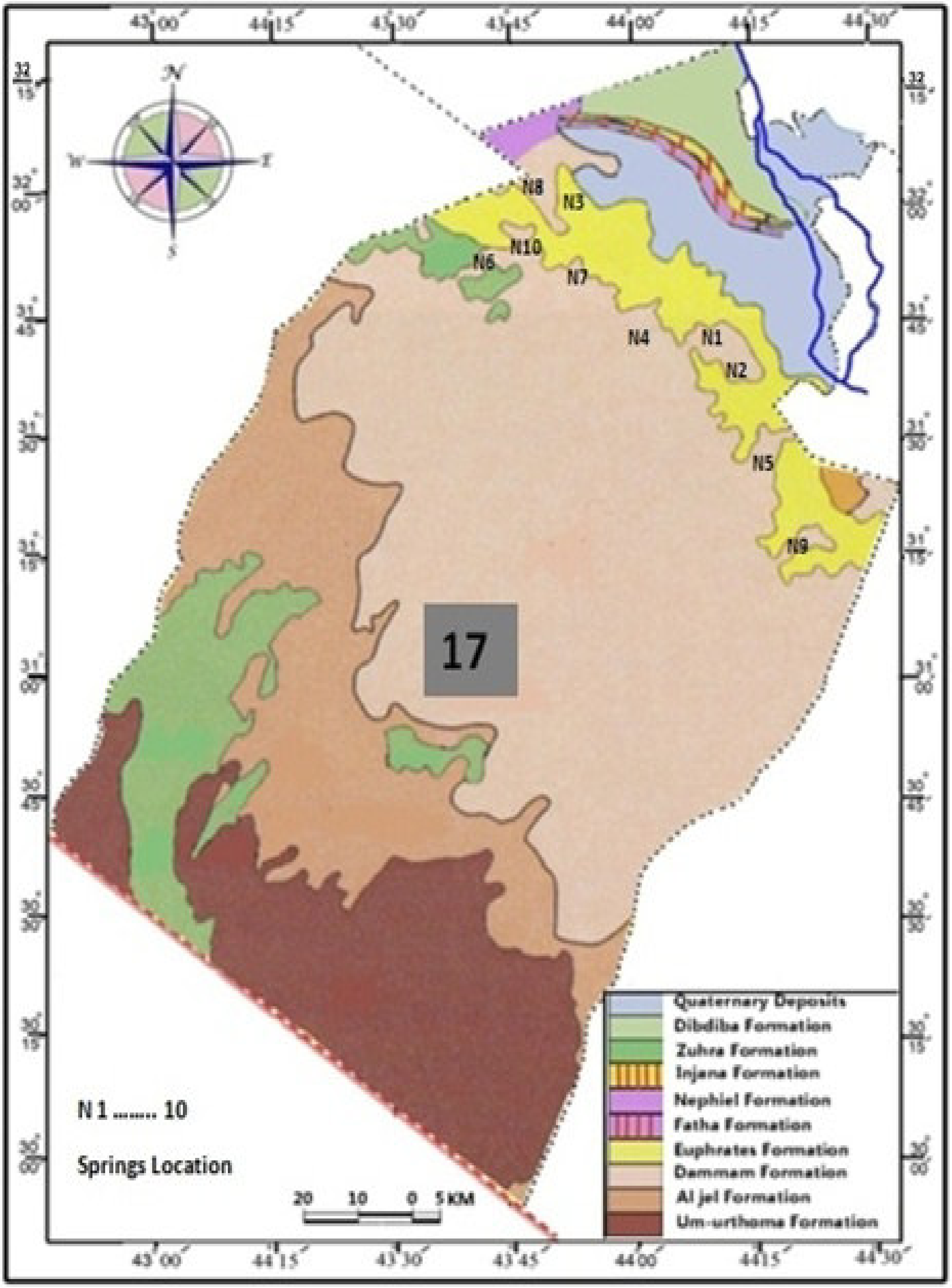

Fig. 1.B : Geologic map for study area.

-Hydrogeology :

The study of hydrogeology includes two layers of groundwater. The first is resent deposits and the second is Miocene deposits. Considered the first layer of little significance because it contains limited amounts of water, while the second layer is important because of containment a large amounts of groundwater under hydrostatic pressure. This leads to the lifting of spring's water naturally above the earth surface. The results of the chemical

analysis for water Miocene layer bearing water have proved the presence of two types of water:
1 - sulfate - magnesium.
2 - Sodium - chloride.

Both types above contain magnesium chloride with the original marine of Miocene water . Springs water seeping from the aquifer above the earth's surface by changes in the permeability of penetration areas, which supports the idea of renewed ancient tectonic movements after the Miocene epoch (Budy.1987).

Through the field views and space photographs(Fig.1.A), the study area is located within the northern end of the Eastern Fold convex too large, a little sloop and it is the heart of the fold in the southern part of Western Iraq desert . the study area is a part of the discharge to the fold, while the catchment area located above the core of the fold, where the aquifers are confined groundwater while the groundwater aquifers in the study area are confined.

The springs of Najaf area are natural drainage area for aquifers convex fold with the general inclination of the area that corresponds with a tendency of layers toward the northwest. This corresponds with the direction of groundwater flow of springs. The direction of groundwater flow in the study area corresponds with the decline of the layers of the earth and convex fold, which corresponds to the flow of groundwater through springs .

-Geology and Stratigraphy :

The study area covers with sedimentary rocks formations ranging in age from upper cretaceous to Quaternary period (Fig.1.B).

The distribution of springs in the study area is north – south. There are many faults in the western desert. The faults have two main direction. First are the deep primary faults with direction north east – south west plus some of complementary faults with direction North West – south east. The second direction is the deep secondary faults with direction north – south and east – west. The springs of study area is located in a depression (Bahar- Al-Najaf) and it is bounded from the north by steep slope cliff. The surface of study area is consisting of sand dunes, rocky floor, alluvium and retaining of wall cliff. Dammam formation is out croup at the western side of study area. The Euphrates formation is over Dammam unconformably then Injana formation conformably. (Table-1) is show the depth and thickness of layers sequence, formation name, lithology and the age of each formation (Hassan.1973).

Tabe-1: Stratigraphic Section for Al-Kifl Well (No.1).

Formation	Age	Lithology	Thickness	Depth
Soil and alluvial deposits and Dibdiba fm	Pleistocene U. Miocene	friable sand gravel, Sand, feldspar and marl	93.5.M	93.5.M
Fatha	M. Miocene	Gypsum, silty gypsum, lime clay and limestone	106.4.M	197.M
Euphrates	L. Miocene	Fine grains limestone with lime clay	43.6.M	303.4.M
Dammam	U. Eocene	Fine grains of dolomitic limestone and lime clay at lower part	189.9.M	374.M
Rus	L. Eocene	Limestone with fine grains of anhydrite and dolomite	73.6.M	536.9.M
Al-Alegy	L. Eocene Paleocene	Lime clay, limestone and dolomite	271.9.M	610.5.M
Shiranish	U. Cretaceous	Lime clay containing a cutting of limestone	67.3.M	882.4M

- Materials and Methods :

Ten (10) water samples were collected from the springs.
Major elements were analyzed by:
Sodium and Potassium : by flamephotomer and Chloride : by Technical U to ralyzer instrument (APHA, 1992).
Calcium and Magnesium : by titration with (EDTA).
Sulfate by : Technical in ultra violet spectrophotometer (U.V).
Carbonate and Bicarbonate : by Technical in volumetric.
TDS by : Vaporization at 105 C º (Boyed. 2000).

-Result and Discussion :

Study of spring's water quality includes a characterization for appearance of a various constituents and the

relationship between these constituents and the materials which is existence in the aquifer. Data of spring's water quality allow important guide for geological history of formations and support of groundwater discharge, recharge, movement and storage (Walton.1970).
Hydrochemical study for springs includes the measurement of color and temperature, electrical conductivity and power of hydrogen (PH) , total dissolved solids and the concentration of major cations and anions.

-Accuracy : Accuracy for measurements of cations and anions in the water samples can be calculated according to following equation (Hem.1989) (kehew.2001).

$$R.D\ \% = \frac{r\sum Cations - r\sum Anions}{r\sum Cations + r\sum Anions} \times 100 \quad \ldots\ldots\ldots\ldots\ldots \quad (1)$$

$$A\ \% = 100 - R.D\% \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

R.D % : Relative Difference.
r Cations and r anions : Summation of positive and negative concentrations (epm).
r : (epm) equivalent per million.
A : accuracy.
Where :
R.D % ≤ 5% ………………. accepted result.
5% ≤ R.D % ≤ 10% ……… accepted with risk.
R.D % > 10% ………….. Unacceptable and can't depend on the result.
Accuracy result for all samples is within acceptable limit.
The measuring of hydrochemical changing is depending on below rule:

EC > TDS > TCS (TCS) = ∑Major Cations + ∑Major Anions.

TCS is calculated Major anions and cations which are less than TDS. EC represents the electrical conductivity for all cations and anions (TDS + TCS).
By comparing between EC, TSC and TDS, The results are acceptable with result accuracy (Fetter.1980).

-Physical Properties :
-Color and Odor, Temperature and PH :
Spring's water are colorless, Temperature is between (24 – 27 C°) with average (25 C°) . PH is between (7.2 – 7.8) with average (7.4) (Table.4).

-Electrical Conductivity (EC) and Total Dissolved Solids (TDS) :
EC : It is ability for(1 cm³) of water to connect electric current at 25 C° (Todd.2005). It is a mark of ions type, temperature and dissolved constituents type (Boyed.2000).
Electrical conductivity is indirect method for salinity measurement (Hem.1991).
The response of the conductance value with temperature may be change at different salts and concentrations, But generally increasing of 1C° of water sample leads increasing about 2% at conductivity.
The range of (EC) is (2320 – 3200) µmho /cm) and the average is (2759) µmhos /cm.

TDS : It is a solids remaining after evaporation of water sample to dryness (Drever.1997). TDS represents summation of all concentrations of cations and anions.
The range of total dissolves solids is (2203 – 3200 ppm) and the average is (2597ppm) (table-4).
Table-2 . Water Classification According to TDS (ppm).

Water class	(Goorel.1958)	(Altoviski.1962)	(Drever.1997)	(Todd.2007)
Fresh water	0 – 1000	0 – 1000	< 1000	10 - 1000
Slightly water	---------	1000 - 3000	1000 – 2000	---------
Slightly-brackish water	1000 – 10 000	3000 – 10 000	2000 – 20 000	1000 – 10 000
Brackish water	10 000 – 100 000	10 000 – 100 000	---------	10 000 – 100 000
Saline water	---------	---------	35 000	---------
Brine water	> 100 000	> 100 000	> 35 000	> 100 000

According to table-2 Water class for sprig's water is slightly water to slightly-brackish water.

- TDS - EC Relationship :

TDS can be nearly calculated by EC value multiplying factor (F) by means of the relation curve between TDS and EC.

Factor (A) is getting from flowing equation:

$$TDS = EC \times A$$

Where:

A : Transmutation coefficient (dimensionless unit).

Factor(A) have a value between (0.5 – 0.9) . The value is depending on the preparation of the ionic concentration) (Boyed.2000). The relationship between EC, TDS and factor (A) can be obtained by drawing EC value on (x axis) and TDS value on (y axis) (fig.2).

Correlation coefficient (r) is calculated to get the power link between EC and TDS as following equation:

When :

r = +1 : Positive correlation coefficient.

r = - 1 : Negative correlation coefficient.

r = 0 : No correlation between TDS and EC.

The correlation coefficient (r) between TDS and CE for water springs is a liner correlation with a mathematical approximation (r = 0.978) (Fig.2).

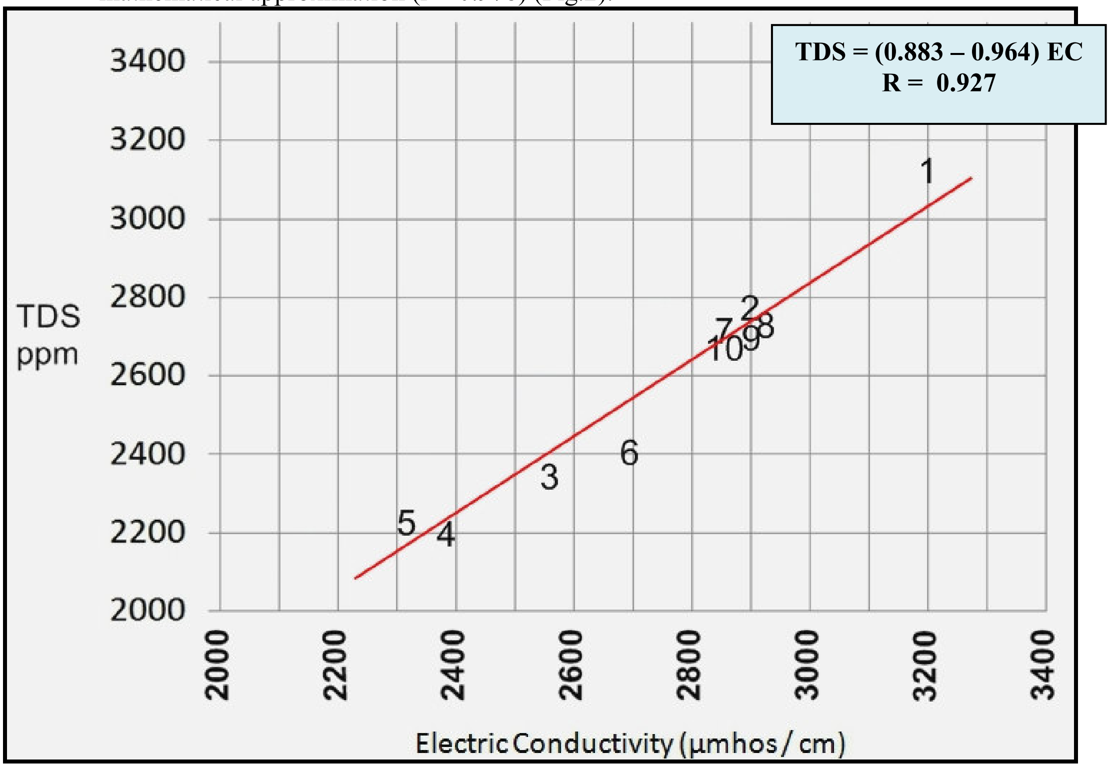

Fig.2 :TDS – EC Relationship for Spring's Water.

- Chemical Properties :

- Major cations (Ca^{+2}, Mg^{+2}, Na^{+1} and K^{+1}) :

Calcium, Magnesium, Sodium and Potassium is alkaline elements.

-Calcium : It is produced of many kinds of rocks and minerals like, carbonate and gypsum rocks, amphibole, feldspar and pyroxene minerals and many kinds of fertilizers (Hem.1989) . The range of calcium in spring's water is (112 – 326 ppm) and the average is (207 ppm). (Table-4).

-Magnesium : Magnesium source is the weathering of different minerals like pyroxene, biotite, amphibole and mica in igneous rocks, Sedimentary rocks such as magnesite, dolomite and brucite. So it found in palygorskitr of clay minerals (AL-Qaraghuli.2005). The range of magnesium in spring's water is (46 – 342 ppm) and the average is (176 ppm)).

-Sodium : The source of sodium is the erosion of feldspar, evaporations rocks and from ionic exchange for clay minerals (Appelo.1999). Most soluble salt at sodium compound is sodium chloride (NaCl) while the sodium bicarbonate (NaHCO3) is the least soluble one.

The range of sodium is (203 – 457 ppm) and the average is (307 ppm).

-Potassium : The source of potassium is the weathering for mica (biotite), microcline, orthoclase and feldspathoid leucite at igneous rocks. It is present in clays like Illite, Sylvite of evaporates rocks and organic remains (Hem.1985).

The range of potassium is (41 – 84 ppm) and the average is (59 ppm).

The distributions of calcium, magnesium, sodium and potassium are controlled by lithology, discharge – recharge rates and ionic exchange.

The resources of Ca^{+2} and Mg^{2} are the calcareous and evaporates materials in the Euphrates and Dammam formation. The highest concentrations of Ca^{+2} and Mg^{+2} are located in high discharge springs at low lying area (Fig.1.B).

The distribution of Na^{+1} and K^{+1} reflects a variety in their sources. First is the mixing of spring's water with Euphrates aquifer water of marine origin and the second is the Euphrates and Fatha aquifer sediments, which are regarding the production of igneous rocks erosion at Arabian shield. This conditions is leading to ionic exchange which is plying a big role in ions concentrations of ions.

-Total Hardness (TH) : It is indicator for presence of Calcium and Magnesium in water. Hardness is precipitated by water heating.
Total hardness is calculated by the following equation:

$$TH = 2.497\, Ca^{+2} + 4.115\, Mg^{+2}$$

Where : TH , Ca^{+2} and Mg^{+2} is measured in ppm.
Hardness is important at evaluation of spring's water for local uses, drinking and industry. It had bad health effect. According to (Todd.2007), water is classified into four degrees of hardness (Table-3).

Tabl-3:.Classification of Water According to Total Hardness (Todd.2007).

Term	Degree of Water Hardness
Soft	$0 < TH \leq 60$
Moderately hard	$60 < TH \leq 120$
Hard	$120 < TH \leq 180$
Very hard	$180 < TH$

The range of hardness for spring's water is (944 – 1687 ppm) and the average is (1228 ppm). According to classification of (Todd.2007), All the spring's water at study area is very hard water.

- Major Anions (Cl^{-1} , $SO4^{-2}$, $HCO3^{-1}$) :

- Chloride Ion Cl^{-1} :

Chloride is one of the most Halogens abundant. The source of chloride is Halite and Sylvite of sedimentary Rocks, Apatite and feldsoathoid of igneous rocks and in the
groundwater as old marine water (Davis and Dewist.1966) (WHO.2006). The range of chloride is between (350 – 952 ppm) and the average is (571 ppm).

- Sulfates Ion $SO4^{-2}$:

Gypsum and anhydrite is the main source of sulfate in spring's water. Also, The oxidation of Barite mineral (BaSO4) is giving sulfate, Besides Fertilizers contains different quantities of sulfate. The H2S gas in the atmosphere of industrial and biological activities is finally oxidized to SO2 and thence to sulfate (Todd.2007) (WHO.1996). The range of sulfate is (548 -1765 ppm).The average is (1007 ppm).

- Bicarbonate Ion $HCO3^{-1}$:

Bicarbonate is the Alkalinity source in surface or groundwater by react with Hydrogen Ion (H^{+}) . It is the most important component for power of hydrogen (PH) of solution. High depletion for (HCO3) into CO3 at (PH > 8.2) and the Hydrogen Ion (H^{+}) will add to the carbonate (CO3) and become dissolved bicarbonate at (8.2 > PH) (Davis and Dewiest.1966). The range of bicarbonate is (45 – 140 ppm). The average is (109 ppm). Results are indicate the dominant of SO4 ions in springs water (Fig. 3). This is meaning existence of source of Sulfate ions and that is assign to the presence of evaporate minerals such as gypsum and Anhydrite of Fatha and Rus Formation sediments. Dammam formation is attracted the anhydrite of Rus formation. This is leading to increase the concentration of sulfate ion.

Chloride shoes increase in some springs water. This increase is a result of mixing by Marine water in Euphrates Formation with Meteoric water in Dammam Formation.

Bicarbonate is variable by power of hydrogen (PH) value, CO2 in the atmosphere and in unsaturated zone of soil. Bicarbonate found in the spring's water in acceptable concentration.

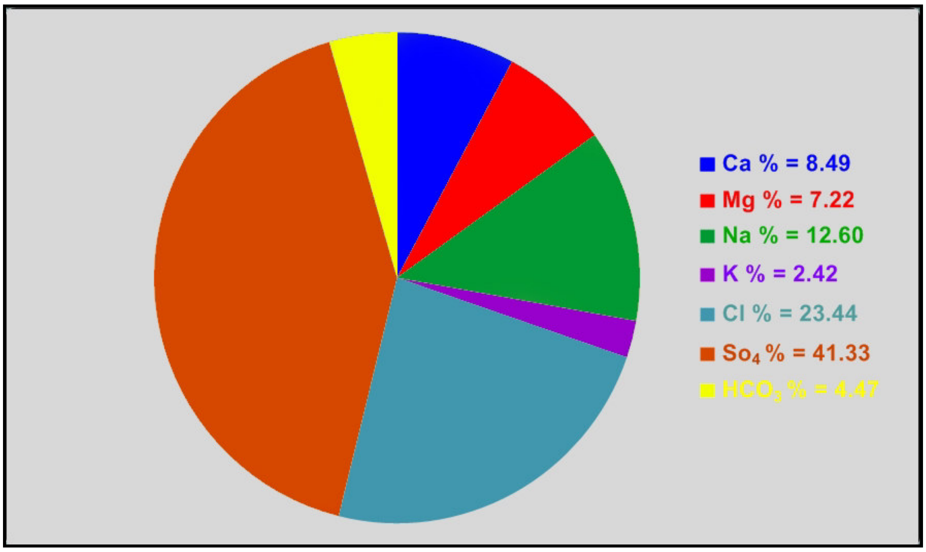

Fig.3 :Average Percentage of Concentrations for Major Ions in Sprigs Water.

Table-4: Major Ions, TDS, EC, Total Hardness, PH and Temperature for Spring's Water. -

Springs name	PH	Total Hardness	EC µmhos /cm	TDS	Units	K	Na	Mg	Ca	CL	SO4	HCO3	Tem C°
1- Staeh	7.3	1182	3200	3117	ppm epm	84 2.14	457 19.8	173 14.2	188 9.4	952 26.9	660 13.7	116 1.9	25
2- Maatook	7.4	1064	2900	2790	ppm epm	74 1.9	348 15.1	91 7.5	276 13.8	868 24.5	548 11.4	45 1.5	26
3- Jaan	7.2	944	2561	2390	ppm epm	72 1.9	382 16.6	76 6.3	252 12.6	588 16.5	560 11.7	116 1.9	26
4- Al-- rohbaan	7.2	986	2390	2203	ppm epm	73 1.9	203 8.8	57 4.7	301 15	462 13	785 16.3	116 1.9	25.5
5- Al-hiaiatheea	7.8	1001	2320	2237	ppm epm	54 1.4	278 12.1	46 3.8	326 16.3	462 13	830 17.3	140 2.3	26
6- Al-rehameah	7.6	1276	2690	2412	ppm epm	41 1.03	263 11.4	196 16.1	188 9.4	380 10.7	1188 24.7	110 1.8	26.5
7-Al-iseaah	7.6	1245	2864	2710	ppm epm	48 1.2	335 14.6	213 17.5	152 7.5	546 15.4	1226 25.5	122 1.99	27
8- Al-assaweed	7.4	1387	2813	2931	ppm epm	56 1.4	266 11.6	251 20.6	143 7.1	714 20.1	970 20.2	116 1.9	26
9- Al-ruhhba	7.3	1681	2890	2701	ppm epm	44 1.1	271 11.9	342 28.1	112 5.6	350 9.9	1765 36.8	109 1.8	26
10- Rweez	7.4	1512	2864	2682	ppm epm	46 1.2	266 11.6	319 26.2	131 6.6	392 11.1	1539 32.1	116 1.9	25.6
	7.4	**1228**	**2759**	**2597**	**Average**	**59**	**307**	**176**	**207**	**571**	**1007**	**109**	**25**

Hydrochemical Formula :

Water type can be known from the hydrochemical formula. It depends on the ratio of major ions (epm%) which had more than (15%) availability.(Ivanov.1968).

(Table-5) shows the hydrochemical formula of spring's water.

$$\text{TDS (ppm)} \frac{(SO4\ .\ Cl\ .\ HCO3)\ \text{epm\%}}{(Ca\ .\ Na\ .\ Mg\ .\ K)\ \text{epm\%}} \text{PH}$$

Table-5: Hydrochemical Formula for Spring's Water.

Spring's Name	Hydrochemical Formula	Water Type
1- Staeh	Cl(63.2).SO4(32.3).HCO3(4.4) TDS(3117) --- PH(7.3) Na(43.5).Mg(31.2).Ca(20.5).K(4.7)	Ca-Mg-Sodium-SO4-Chloride NaCl
2- Maatook	Cl(65.4).SO4(30.4).HCO3(4.1) TDS(2790) --- PH(7.4) Na(39.5).Ca(35.9).Mg(19.5).K(4.9)	Mg-Ca-Sodium-SO4-Chloride NaCl
3- Jaan	Cl(55).SO4(38.6).HCO3(6.2) TDS(2390) --- PH(7.2) Ca(39.4).Na(35).Mg(19.6)K(5.7)	Mg-Na-Calcium-SO4-Chloride CaCl2
4- Al-rohbaan	SO4(52.2).Cl(41.6).HCO3(6) TDS(2203) --- PH(7.2) Ca(49.4).Na(29).Mg(15.3).K(6.1)	Mg-Na-Calcium-Cl-sulfate CaSO4
5- Al-hiaiatheea	SO4(52.9).Cl(39.9).HCO3(7) TDS(2237) --- PH(7.8) Ca(48.6).Na(36.1).Mg(11.1).K(4)	Na-Calcium-Cl-Sulfate CaSO4
6- Al-rehameah	SO4(66.5).Cl(28.5).HCO3(4.8) TDS(2412) --- PH(7.6) Mg(42.5).Na(30).Ca(24.6).K2.7)	Ca-Na-Magnesium-Cl-Sulfate MgSO4
7-Al-iseaah	SO4(59.4).Cl(35.8).HCO3(4.6) TDS(2710) --- PH(7.6) Mg(42.9).Na(35.7).Ca(18.3).K(2.9)	Ca-Na-Magnesium-Cl-Sulfate MgSO4
8- Al-assaweed	SO4(47.8).Cl(47.7).HCO3(4.4) TDS(2731) --- PH(7.4) Mg(50.6).Na(28.3).Ca(17.4).K(3.5)	Ca-Na-Magnesium-Cl-Sulfate MgSO4
9- Al-ruhhba	SO4(75.9).Cl(20.3).HCO3(3.6) TDS(2701) --- PH(7.3) Mg(60).Na(25.5).Ca(12).K(2.4)	Na-Magnesium-Cl-Sulfate MgSO4
10- Rweez	SO4(71.2).Cl(24.5).HCO3(4.2) TDS(2682) --- PH(7.4) Mg(57.6).Na(25.3).Ca(14.3).K(2.5)	Na-Magnesium-Cl-Sulfate MgSO4

Result shows (Table-5) predominate of Magnesium sulfate (MgSO4) salt at spring's water. It consists (50%) of total samples. The locative distribution for other salts are (20%) for calcium sulfate and sodium chloride with (10%) for calcium chloride. More over the sulfate water type (SO4) is consisting (70%) of spring's water. This is meaning, sulfate water is a result for chelating of sulfate ions from Rus formation (Table-1) by spring's water. The existence of sulfate water type is revere to the effect of the geological factor represented in the evaporate sediments like gypsum and anhydrite. Also spring's water contains a considerable concentrations of chloride (Cl). (Meybeck.1983) referred that about (55%) of chloride ions in the ground water are from rocks erosion, and about (45%) of Chloride are from rain cycles. The increase at Chloride is coinciding with the decrease at sulfate ions concentrations.

- Hypothetical Salts :

It is depending on the solubility product for each salt. When the salt is forming first in the solution, The same salt will deposit last during the deposition of salts.

Table-6 shows the predominance of the magnesium sulfate (MgSO4) salt that is ascribed to the same reasons at discussion of hydrochemical formula.

Table-6: Hypothetical Salts for Springs Water.

Hypothetical Salts	Frequency	Existence%
KCl	0	0
NaCl	2	20
MgCl2	0	0
CaCl2	1	10
K2SO4	0	0
Na2SO4	0	0
MgSO4	5	50
CaSO4	2	20
KHCO3	0	0
NaHCO3	0	0
Mg(HCO3)2	0	0
Ca(HCO3)2	0	0

- Origin of Springs :

The ratio of positive and negative ions (Table-7) is used to get the origin of water (Sullin.1946 in Al-Fatlawi.2010). The ratio (rNa / rCl) between sodium ion concentration (epm) and chloride ion concentration (epm) is explained the origin of water as follows :

r Na / r Cl = More Than One …………. Continental Water.

r Na / r Cl = Less Than One …………. Marine Water.

The origin of groundwater is atmospheric during and after deposition and of continental or marine origin when the groundwater belongs to older periods, So the environment of groundwater at aquifers may be diluted or concentrated with different ions, Thus two classes can be distinguished for the origin of ground water depending on the ratio of (rNa / rCl). (Sullin.1946 in Al-Fatlawi.2010) is found the concentration or the dilution ratio by comparing the hypothetical salts in spring's water with the concentration of sea or continental water. (Fig.4) shows the plot of spring's water.

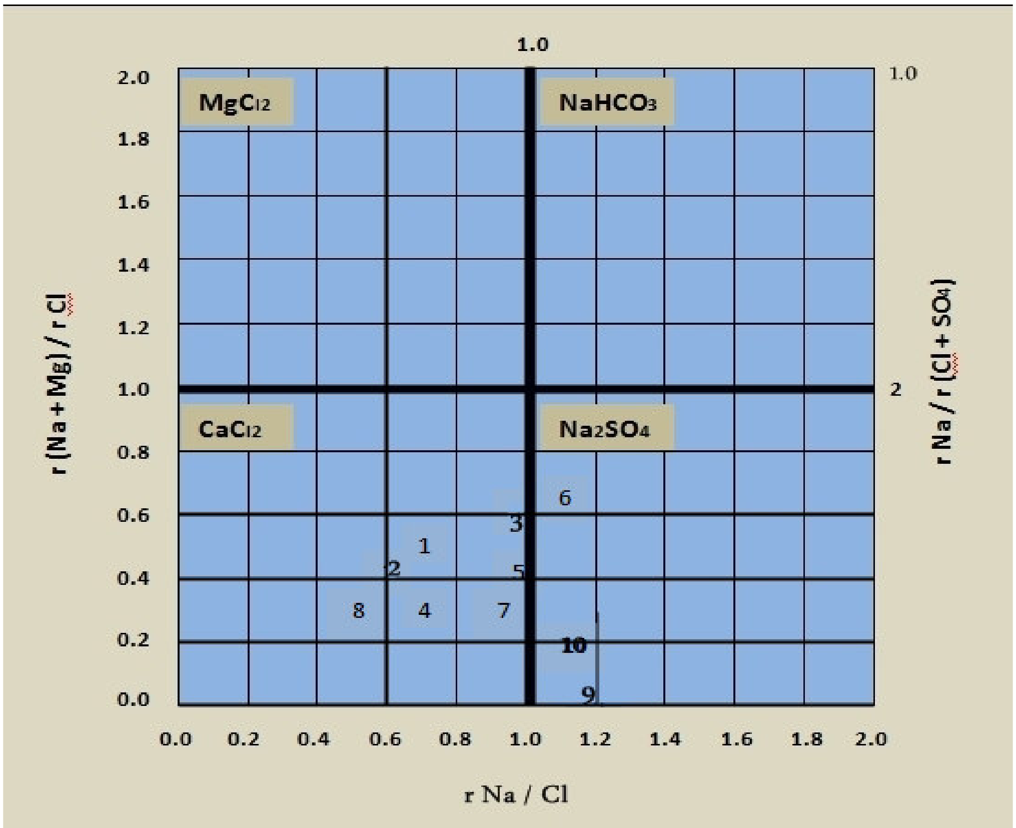

Fig.4: Groundwater Origin Diagram (Sullin.1946).

According to (fig.4) , Most the spring's water (70%) is of marine origin (CaCl2), while the others (30%) are of continental origin (Na2SO4).

Table-7: Average of Hydrochemical Ratios for Spring's Water.

Springs No.	rNa / rCl	rNa / r (Cl+SO4)	r (Na+Mg) / rCl	Origin
1- Staeh	0.74	0.49	1.20	Marine
2- Maatook	0.62	0.42	0.92	Marine
3- Jaan	0.99	0.59	1.06	Marine
4- Al-rohbaan	0.68	0.30	1.03	Marine
5- Al-hiaiatheea	0.93	0.40	1.20	Marine
6- Al-rehameah	1.07	0.32	2.60	Continental
7-Al-iseaah	0.95	0.36	2.08	Marine
8- Al-assaweed	0.58	0.29	1.60	Marine
9- Al-ruhhba	1.20	0.25	4.00	Continental
10- Rweez	1.05	0.27	3.40	Continental

References:

Todd, D .K., 2007 : Groundwater Hydrology. Second edition, John Wikky and Sous, Third Reprint. Inc. India.

Al-Fatlawi, A. N.,2010 : Hydrogeological Study for Umm Er Radhuma Aquifer – West of Iraq. PH.D. Thesis. Baghdad University. Iraq. (unpub).

Buday, T. and Jassim, S. Z., 1987 : The Re4gonal Geology of Iraq (Tectonism, Magmatism and Metamorphism) , 325P.

Hassan. A. H., 1973 : Hydrological, hydrogeological and hydrogeochemical Investigations of Bahar Al-Najaf area (unpub). M.Sc. Thesis.

APHA , 1992 : Standard Methods for the Examination of Water and Wastewater. American Public Health Association, New York. 16th ed.

Boyed, C. E., 2000 : Water Quality an introduction, Kluwer Academic Publisher, USA. 330P.

Walton, C. W., 1970 : Groundwater Resource Evaluation McGraw Hill CO., 664P.

Kehew, A. E., 2001 : Applied Chemical Hydrology. Prentice Hall, New Jersey, 368P.

Fetter, C. W., 1980 : Applied Hydrogeology, Charles Merrill Pub. Co. A. B. Bell and Howell Company, Columbus, Ohio, 488P.

Todd, D. K., 2005 : Groundwater Hydrology (3ed edition) . Jhon Wiley and Sons, New York, USA, 650P.

Hem, J. D.,1991 : Study and Interpretation of the Chemical Characteristics of Natural Water. USGS Water Supply. Paper no. 2254, 263P.

Drever, J. I., 1997 : The Geochemistry of Natural Water, Surface and Groundwater Environments, 3rd ed., prentice Hall, USA, 436P.

Hem, J. D., 1989 : Study and Interpretation of the Chemical Characteristics of Natural Water U.S Geological Survey, Water Supply Paper 2254, 246P.

AL-Qaraghuli, N. A.,2005 : Content of Nutrient elements (Total, Water Soluble and available) in Fertilizers (TSP, MAP, NP& NPK) Produced from Al-Qaim Plant, Iraqi Journal of Agricultural Science, Vol. 36, No. 5, PP35-41.

Appelo, C. A. J. and Postma, D., 1999 : Geochemistry, Groundwater and Pollution. Rotterdam : A. A. Balkama, 536P.

Hem. J. D.,1985 : Study and interpretation of the Chemical Characteristics of Natural Water. 3rd. U.S.G.S. Water Supply Paper. 2254. 263P.

Davis, S. N., and Dewest, R.J.M., 1966 : Hydrogeology, Johan Wiley and Sons. Inc., NEW York. 464P.

WHO, World Health Organization, 2007 : Guide Fine for Drinking Water Quality Recommendation Vol. 4th ed. 36P.

WHO, World Health Organization, 1996 : Guideline for Drinking Water Quality, 2rd Edition, Vol.2: Recommendations, World Health Organization, Geneva, 951P.

Ivanov. V. V., Barvanov. L. N. and Plotnikova.G. N., 1968 : The Main Genetic Type of The Earth's Crust Minerals Water and Their Distribution in USSR, Inter. Geol. Cong. Of 23rd Sessions, Czehholoslovakia, Vol. 12, 33P.

Meybeck, M. 1983 : Atmospheric Inputs and River Transport of Dissolved Substances. In : Dissolved Loads of Rivers and Surface Water, Quality/Quality Relationship. Proc. Hamburg Symposium, Wallingford, U.K;LAHS Publ.

ISSN 2224-3186 (Paper) ISSN 2225-0921 (Online)
Vol.5, No.7, 2015

أصل ينابيع النجف.جنوب غرب العراق.

سعدي عبد الجبار موسى الدهان
جامعة الكوفة
مركز التحسس النائي

المستخلص

تقع ينابيع المياه ضمن محافظة النجف الاشرف في غرب جنوب العراق, حيث تتوزع على امتداد الحافة الشرقية للصحراء الغربية . تنتشر الينابيع في منطقة الدراسة بين خطي العرض (¯32 ° . 15¯ – 31 ° . 00) و الطول (44 ° . 30 – 43 ° . 30¯ الدراسة . اوضحت الهيدروجيولوجية للمنطقة وجود طبقتين حاملتين للمياه الجوفية, الأولى هي رواسب العصر الحديث والثانية رواسب عصر المايوسين المهمة وذلك لاحتوائها على كميات كبيرة من المياه الجوفية. وجد إن نوعية مياه الينابيع نسبة إلى الأملاح المذابة الكلية هي مسوس ضعيف إلى ضعيف.

بينت الدراسة إن نوعية مياه الينابيع نسبتا الى تواجد العسرة الكلية هي مياه عسرة جدا وان الملح السائد هو كبريتات المغنيسيوم وكلوريد الصوديوم وذلك استنادا الى نسبة الاملاح الافتراضية الموجودة في مياه الينابيع وان نوعية المياه السائدة ة هي مياه الكبريتات وذلك استنادا الى الايون السائد. هي مياه قارية %30)من مياه الينابيع هي مياه بحرية الأصل ومن نوع كلوريد الكالسيوم وان مياه الينابيع الأخرى ((%أوضحت االاليكتروني: الأصل ومن نوع كبريتات الصوديوم.

البريد الاليكتروني : dr_saadialdahaan@yahoo.com