Hydrogeochemical properties of ground water in the vicinity of al-hawija plain se-Kirkuk, Iraq

Soran N. sadiq
College of science - University of Kirkuk

Abstract

AL-Hawija plain is located at the south western part of Kirkuk city(N-IRAQ),with in the Hammrin-Makhul tectonic sub zone,the area is of simple topography with an average elevation of (360 m.a.s.l.),having a semi-arid climate.Cultivation in the area depends on the rain water,and groundwater that has been extracted mainly from Miocene age,Pliocene fluvial sediments and recent deposits.The present study is mainly concerned with the evaluation of the quality of ground water to the different purposes.11ground water samples has been chemically analyzed from selected wells extracting water from different depths(80-120)m.and found that the ground water is of meteoric origin,very hard,having high PH values,while the values of total dissolved solids(TDS)are ranging between(1000-4500)mg/l,so that the water is of brackish type.on the basis of the major cation and anion concentration the groundwater is of(mixed Na and Ca-SO_4) group having three families which are(Na_2SO_4)family with Na^+>Ca^{+2}>Mg^{+2}-SO_4^{-2}>Cl^->$HCO_3^-$and($CaSO_4$)water familyCa^{+2}>Mg^{+2}>Na^+-SO_4^{-2}>Cl^- >HCO_3^-, and ($MgSO_4$) family with Mg^{+2} > Na^+ > Ca^{+2}-SO_4^{-2} > Cl^- > HCO_3^-. Generally the ground water in the area were not recommended for drinking purposes because of high salinity and it is(Doubtful to unsuitable-Unsuitable)for irrigation whereas it can be used to cultivate sensitive crops in areas of medium to coarse grained soil having a well designed drainage system beneath the agricultural.

Introduction

The study area is located some(65)Km to the southeast of kirkuk city (North Iraq),it is situated between latitude(35^0.4-35^0.65)and longitude (43^0.47-43^0.87),the total area of the catchment area of the plain is about (165)$Km^2$the plain is bounded by the Lasser Zab river from north and west side and by Tigris river from the southeastern side(Fig1).The area is of simple topography,having a gentle slope terrains with elevations of(300-365)m.above mean sea level.The area is characterized by a semi-arid climate.Selected weather parameters are presented in table(1).Because of the prevailing semiarid conditions,the area is rain fed cultivated by wheat, but due to the agricultural development and expansion of such rural and agrarian city then it has to make use of all the assured supply of water

from different resources especially from groundwater wells.Therefore,the aim of the current study is to investigate the hydrochemical properties of the roundwater within the plain as well as its validity for different uses

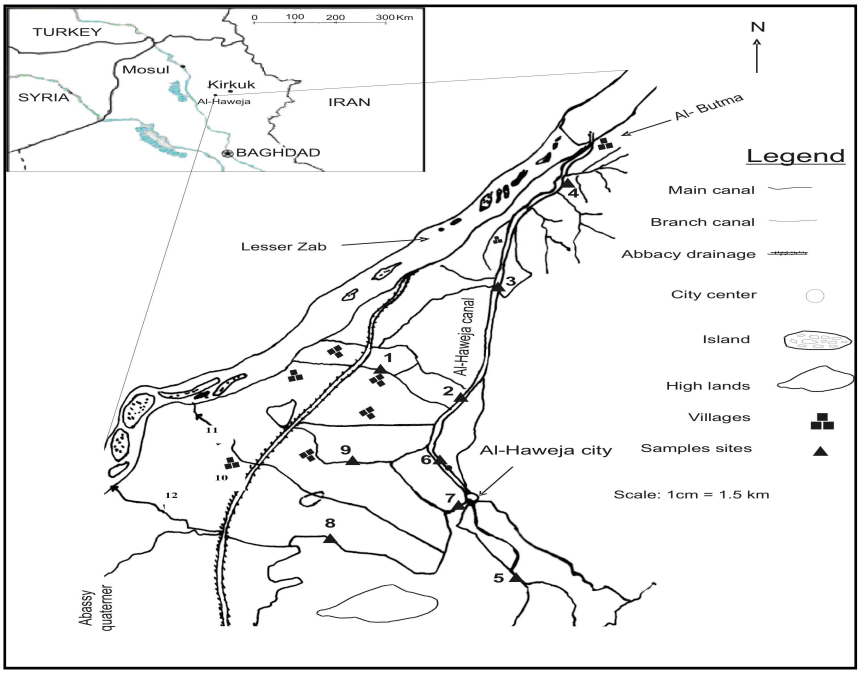


Fig.(1): Location map of the studied area

Table (1)**:** Selected weather parameters(1990-2005) as obtained from al-hawija irrigation office

Property	**Min.**	**Max.**	**Av.**
Temperature(C^o)	-3	49	20
Evaporation(mm)	31	440	230
Rainfall(mm)	0.2	198	58

Geological and Hydrological outlook

The examined area is a part of the low folded zone of northern Iraq, lying within the Hamrin - Makhul tectonic subzone of the unstable shelf area from Nubia - Arabia platform (Buday & Jassim ,1987) .Stratigraphically , the rock formation which are exposed and covered the plain and the surrounding ridges,were generally ranging from Miocene age formations represented by Fatha and Injanah formations that outcrops along the border of the plain, whereas the Pliocene age formation(Miqdadia formation) has an extensive outcrop along the ridges within the plain ,Pleistocene and recent age formations(Alluvium,flood plains and wadi deposits)covers mainly the middle part of the plain.The water bearing formations are thick bedded sediments of

Miqdadia formation(mainly consist of gravel and pebbly beds with silt, clay and sand which partially acts as cementing materials),old and recent alluvium beds(alluvium flood plain terraces consisting series of beds and lenses of sand,silt and clay varying vertically and laterally),the thickness of the alluvium is about(150 m.)at the centre of the plain and dimishes outward.The depth to groundwater increases from below of(10m.)to over(30m.)in the higher parts of the plain.The groundwater movement in general is from recharge area in the northeast to the southwest with inclination to converge toward the Tigris river.Majority of the drilled wells penetrates deeply to the Bakhtiary formation producing water from both Bakhtiary and the alluvium deposits.

Materials and Methods

Water samples for chemical analysis were collected from a selected(11) peizometers well distributed within the examined area. Samples were collected from a few meters below water level using water sampler in clean and sterile polythene bottles. Standard procedures and techniques table(2) were used in the analysis which include the measurement and estimation of TDS,PH,Total salinity,Total Hardness and the evaluation of the main cation and anion concentrations in the water .

Table(2):Analytical instruments used for the determination of the major ions in groundwater samples

Ions	**Analytical method & instruments**
Na^+, K^+, Ca^{++}, Mg^{++}	Atomic absorption spectrophotometer. Type(Hitachi–180-30)
SO_4^{--},Cl^-, HCO_3^-,NO_3^-	Spectrophotometer Double Beam . Type(UV–150–02)
Electric Conductivity	Conductivity-meter type DS–8 F–Japan
PH	PH–meter type(No-ser.211)

The data table(3)were subjected to a test of accuracy by computing the ion balance to examine the degree of reliability of the obtained results (Hem,1970), the result shows that the significant differences in the concentration of major constituents is less than10%,so it has high precision and accuracy level.

Table(3):Chemical composition and properties of water samples from the study area

Well No.	Depth (m.)	TDS ppm	E.C µmohs/cm	PH	Ca epm	Mg epm	Na epm	K epm	Cl epm	SO_4 epm	HCO_3 epm	Error %	TH ppm	Na%
1	86	2446	2878	8.2	12.48	9.7	14.27	0.141	6.99	26.86	2.79	0.1	1109.8	39.4
2	158	3200	3300	7.8	18.96	15.79	6.01	0.205	4.59	29.98	2.79	4.6	1738.9	15.1
3	166	2083	2210	8.1	7.59	6.82	16.48	0.639	2.76	23.98	2.39	3.9	721.1	54.3
4	96	2850	4300	8.0	1.79	20.07	11.0	0.69	8.79	33.73	1.7	13.7	1093.9	34.8
5	120	3120	4390	8.2	8.74	3.33	16.86	0.256	13.25	18.53	6.06	12.9	1207	58.6
6	120	4016	5500	7.7	22.36	14.47	26.01	0.537	14.01	45.97	1.18	0.2	1842.9	41.9
7	110	3240	3860	8.1	16.24	6.21	3.69	0.076	5.92	9.78	5.72	10.01	2244	14.3
8	134	4611	5600	7.6	15.17	15.21	31.33	0.384	16.79	35.97	1.99	2.2	1511.4	50.9
9	120	997	1150	7.6	5.59	4.11	6.0	0.051	3.61	9.58	3.19	1.9	485.4	38.4
10	94	3410	3980	7.8	8.74	2.92	5.21	0.179	9.02	4.99	4.65	4.5	1116	31.6
11	96	1182	2000	8.0	7.98	6.91	5.0	0.358	3.21	12.99	2.78	3.2	745.2	26.4

Result and Discussion

Hydrochemical Criteria

The total dissolved solids(TDS)for the selected groundwater samples ranges between(1000-4500)mg/l with an average of(2830mg/l),having a general trend of increasing salinity toward the southeast and northwest due to the direct infiltration of rainwater via the soil and the unsaturated zone, also due to the local recharge of surface runoff via permeable wadi beds or drainage systems(Edmund&Walton,1980),However, the groundwater in the area according to(Gorell,1958)is of brackish type.The PH values were ranging between(7.6-8.2)with an average of(7.9)indicating alkaline reaction conditions,there is a general,though not consistent,trend of high PH values in shallow groundwater aquifers(Hem,1989).The concentration of Ca^{+2}, Mg^{+2},Na^{+},Cl^{-},$SO4^{-2}$,$HCO3^{-}$ ions depends on the rock mineralogy that the water encounter and its rapidity along the flow path .The major anion concentration is sulphate (SO_4^{-2}) ion were ranging between (460-2200) mg/l with an average (1100 mg/l), such concentration is derived from dissolution of gypsum and salt lenses characterizing the Pliocene fluvial sediments within the area.However,the dominated cation is either sodiumion or calcium ion mainly derived by leaching salts through the soil and by dissolution of limestone,anhydrite and dolomite rocks(Malcom &Soulsby,2001),whereas clay minerals also enhance exchange of $Na^{+}$with Ca^{+2}(Na^{+}comprises 14.3-58.6 % of the total milliequivalents values of cations).According to(Todd,1980)the groundwater is very hard (TH>300mg/l)as the estimation of the total hardness within the samples were ranging between(485-1850mg/l),such fluctuation in the hardness values is might be due to the Ca and Mg ion concentrations.

Groundwater Quality

Using Trilinear diagram(Piper,1944)the groundwater is characterized by mixed sodium-calcium cation facies and by sulphate anion type as shown in figure(2),it also indicates that(45%)of the samples has the characteristics of secondary salinity and non-carbonate hardness,also(36%)of the samples has the domination of sodic acid(Weak acids)properties.

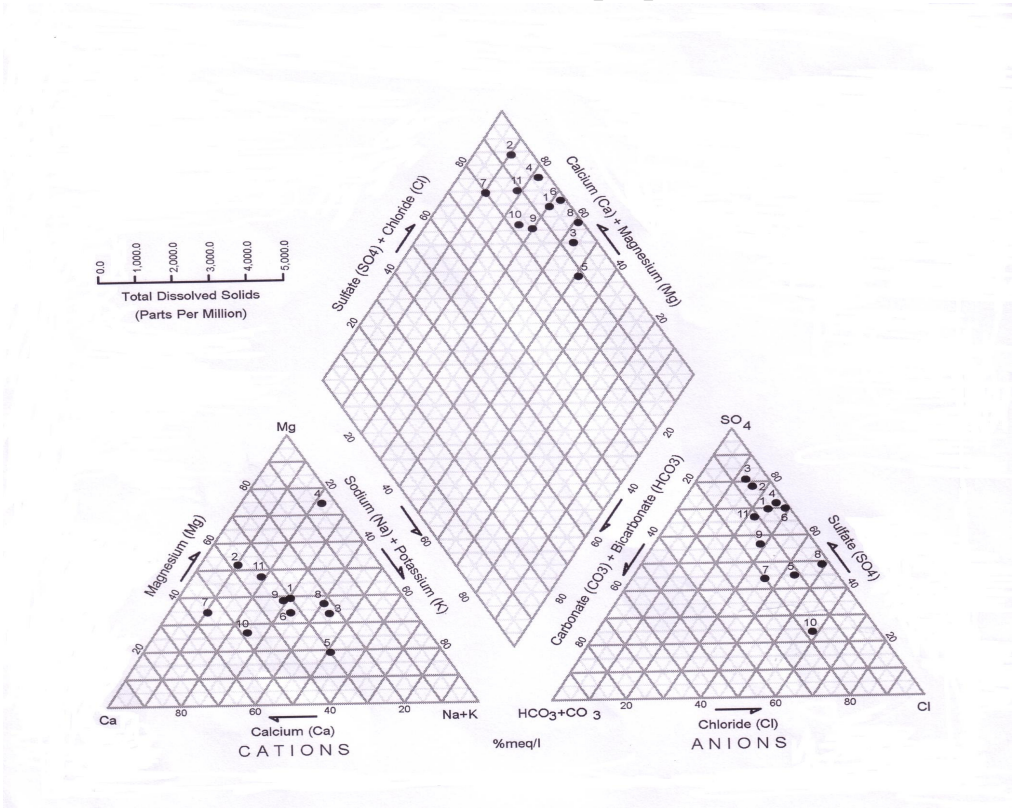


Fig.(2): Piper diagram for the groundwater samples of the studied area.

Using(Hassan et al.,1988)technique for classification purposes table(4),90%of the samples are of(Sulphate Group)having three families which are:(Na_2SO_4) family,comprises55%of the samples in which the cation sequence is $Na^{+}>Ca^{+2}>Mg^{+2}$and the anion sequence is$SO_4^{-2}>Cl^{-}>HCO_3^{-}$where Na+K>Cl and ($CaSO_4$)water family(35%of the samples)with cation sequence $Ca^{+2}>Mg^{+2}>Na^{+}$ and the anion sequence is $SO_4^{-2}>Cl^{-}>HCO_3^{-}$where Na+K>Cl,and finally ($MgSO_4$)family with cation sequence $g^{+2}>Na^{+}>Ca^{+2}$and the anion sequence is $SO_4^{-2}>Cl^{-}>HCO_3^{-}$.From the above ordering of the anions and cations,it is suggested that the ground water in the aquifer is completely replaced by lateral flow of the meteoric water of an SO_4-Na genetic water type,while the

reasons behind these different water types can be refers to the active ion exchange between the groundwater and the rock formation(Al-Ruwaih,F. & Hadi,K.2007).

Table (4): Hydrochemical parameters of groundwater samples

Well No.	Group	Family	Type	Hypothetical Salts
1	Sulphate	Na-SO_4	Na>Ca>Mg-SO_4>Cl>HCO_3	$MgSO_4$(26.5),$CaSO_4$(26.4),Na_2SO_4 (20.3),NaCl(18.7),$Ca(HCO_3)_2$(7.6),KCl(2.0)
2	Sulphate	Ca-SO_4	Ca>Mg>Na-SO_4>Cl>HCO_3	$CaSO_4$(38.8),$MgSO_4$(38.5),NaCl(11.8), $Ca(HCO_3)_2$(7.4),Na_2SO_4(2.9),KCl(0.5)
3	Sulphate	Na-SO_4	Na>Ca>Mg-SO_4>Cl>HCO_3	Na_2SO_4(44.8),$MgSO_4$(21.6),$CaSO_4$(15.8), $Ca(HCO_3)_2$(8.2),NaCl(7.4),KCl(2.0)
4	Sulphate	Mg-SO_4	Mg>Na>Ca-SO_4>Cl>HCO_3	$MgSO_4$(59.8),NaCl(17.8),Na_2SO_4(14.9), $Ca(HCO_3)_2$(3.87),KCl(2.0),$CaSO_4$(1.5)
5	Sulphate	Na-SO_4	Na>Ca>Mg-SO_4>Cl>HCO_3	NaCl(34.1),Na_2SO_4(23.6),$Ca(HCO_3)_2$ (16.0),$CaSO_4$(13.9),$MgSO_4$(11.4),KCl(0.8)
6	Sulphate	Na-SO_4	Na>Ca>Mg-SO_4>Cl>HCO_3	$CaSO_4$(33.3),$MgSO_4$(22.8),NaCl(22.0), Na_2SO_4(19.0),$Ca(HCO_3)_2$(1.9),KCl(0.8)
7	Sulphate	Ca-SO_4	Ca>Mg>Na-SO_4>Cl>HCO_3	$CaSO_4$(35.2),$Ca(HCO_3)_2$(26.7),NaCl(14.0), MgCl(13.2),$MgSO_4$(10.4),KCl(0.2)
8	Sulphate	Na-SO_4	Na>Ca>Mg-SO_4>Cl>HCO_3	NaCl(40.7),$MgSO_4$(24.5),$CaSO_4$(21.4), Na_2SO_4(9.6),$Ca(HCO_3)_2$(3.0),KCl(0.6)
9	Sulphate	Na-SO_4	Na>Ca>Mg-SO_4>Cl>HCO_3	$MgSO_4$(26.0),NaCl(21.7),$Ca(HCO_3)_2$(19.4), Na_2SO_4(16.3),$CaSO_4$(16.0),KCl(0.3)
10	Chloride	Ca-Cl	Ca>Na>Mg-SO_4>Cl>HCO_3	$MgSO_4$(26.5),$CaSO_4$(26.4),Na_2SO_4(20.3), NaCl(18.7),$Ca(HCO_3)_2$(7.6),KCl(2.0)
11	Sulphate	Ca - SO_4	Ca>Mg>Na-SO_4>Cl>HCO_3	$MgSO_4$(26.5),$CaSO_4$(26.4),Na_2SO_4(20.3), NaCl(18.7),$Ca(HCO_3)_2$(7.6),KCl(2.0)

Hypothetical salt combination has been calculated for the samples by(meq %)and the result shows the possible existence of(Na_2SO_4,$CaSO_4$,$MgSO_4$) salt indicating the semi confined condition of the aquifer system and that the water is of meteoric origin(Collins,1975).The existence of $MgCl_2$ and the absence of $CaCl_2$ confirm the mixing state of the meteoric water with the deep groundwater.The salts are derived from the gypsum and anhydrite dissolution,while the lenses of the clay minerals provides the aquifer water with Na^+ ions and consume ions through the cation exchange process.the general increase of Na>Cl confirm the meteoric origin of the water and indicates the occurrence of a natural softening process which depletes the Ca^{+2}ions and increase the Na^+ions in the aquifer water(Hounslow,A.,1995). Comparing $SO_4^{-2}$with Ca^{+2}ion concentration assume that the primary sources of these ions are gypsum or anhydrite dissolution,only sample No. (10)showed that Ca^{+2}exceeds SO_4^{-2}ions indicating that there is another source for Ca^{+2},which is may be carbonate or silicate,the other water

samples has SO_4^{-2}>Ca^{+2}which indicate the removal of $Ca^{+2}$by either ion exchange or Calcite precipitation.By inspecting the relationship between non-gypsum Ca^{+2}(i.e.Ca^{+2}-SO_4^{-2})and non-halite Na^{+}(i.e.$[Na+K]^{+}$-Cl^{-})shown in the graph in Fig.(3)it was found that the ion exchange process is likely to occur in this aquifer since non-gypsum Ca^{+2}increases with decreasing non-halite Na^{+}.

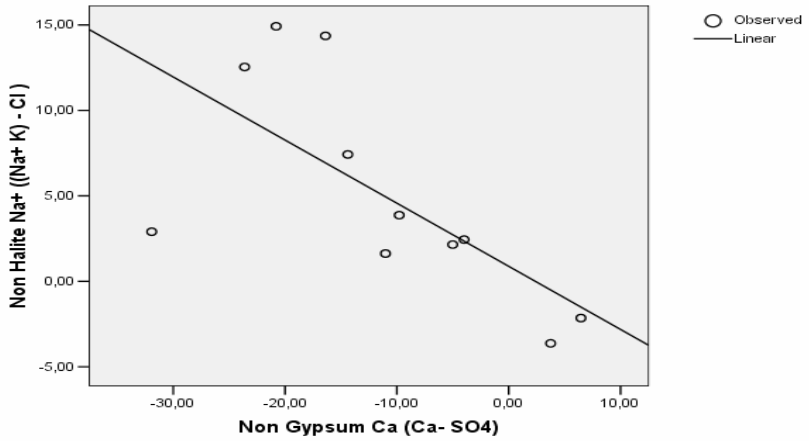
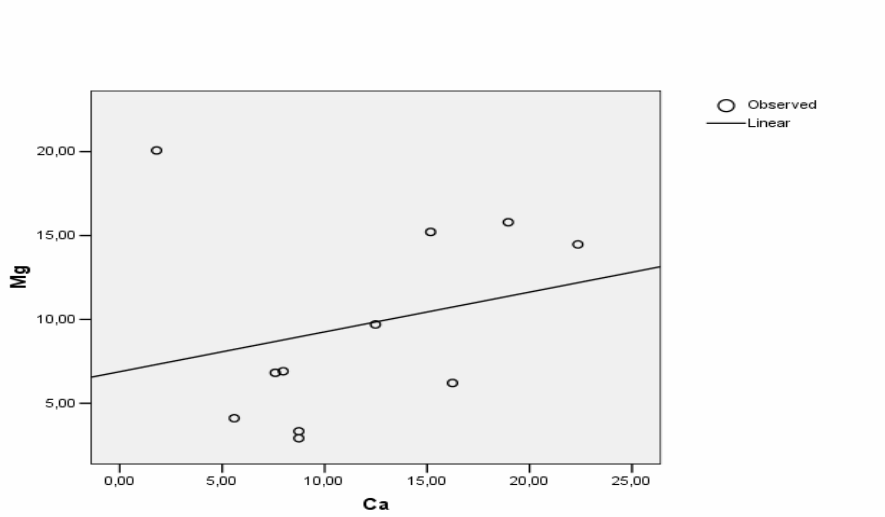


Fig.(3):The relationship between non-halite sodium and non-gypsum calcium in the groundwater aquifer

Fig.(4)illustrate that there is a systematic increase in $Mg^{+2}$with Ca^{+2}which indicates the dissolution of dolomite is likely to occur in this aquifer.



Fig(4):The relation between calcium and magnesium in the groundwater aquifer

Hydrochmical Indicators

the ionic ratios(rNa/rCl),(rSO4/rCl),((rNa-rCl)/rSO_4)and(rCa/rMg)were calculated for the water samples(table 5)and their values was ranging between(1.16-2.04),(1.4-8.6),(0.05-0.76)and(1.0-2.99)respectively. Accordingly,as(rNa/rCl>1),then the origin of the groundwater is designated as meteoric water,while the increase in the value of(rNa/rCl)and(rSO_4/rCl) decrease in the ratio((rNa-rCl)/rSO_4)represent the effect of water of continental origin which is mixed with the original marine water in the natural system continuously

Table (5) :Hydrochmical ionic ratio for the water samples

Well No.	Ionic Ratio			
	rNa/rCl	rSO_4/rCl	rNa-Cl/rSO_4	rCa/rMg
1	2.04	3.84	0.27	1.28
2	1.31	6.53	0.05	1.20
3	5.97	8.69	0.57	1.11
4	1.25	3.83	0.06	0.10
5	1.27	1.40	0.19	2.62
6	1.85	3.28	0.26	1.54
7	0.62	1.65	0.23	2.61
8	1.16	1.34	0.12	1.00
9	1.66	2.65	0.25	1.36
10	0.58	0.55	0.76	2.99
11	1.56	4.06	0.14	1.15

Groundwater use

Comparison with the(W.H.O.,1993)standards and Iraqi standards (IRS)(Hassan&Musa,1983)indicates that the concentration of ions and TDS values were generally within the acceptable to unusable limits for human use,accordingly the water is not recommended for drinking purpose. Using (Crist&Lowry,1972)standards for animal use,the suitability of water was ranging between acceptable to bad and it might be recommended for most of animal use.The suitability of groundwater for irrigation is related to its effect on soils,crops and management techniques used to control for water quality related problems(Ayers&Westcot,1976),the principal factors that degrade a water with respect to its use for irrigation are the TDS,total salinity,electric conductivity, relative amount of Na^+percent(Na%),sodium adsorption ratio(SAR)and residual sodium carbonate(RSC).According to classification suggested by(Wilcox,1948) ,the examined samples were fall in the limits of(Doubtful to Unsuitable)to

Unsuitable water for irrigation Fig.(5)due to the high salt concentration in conjunction with a medium to high sodium percentage(15%-59%).

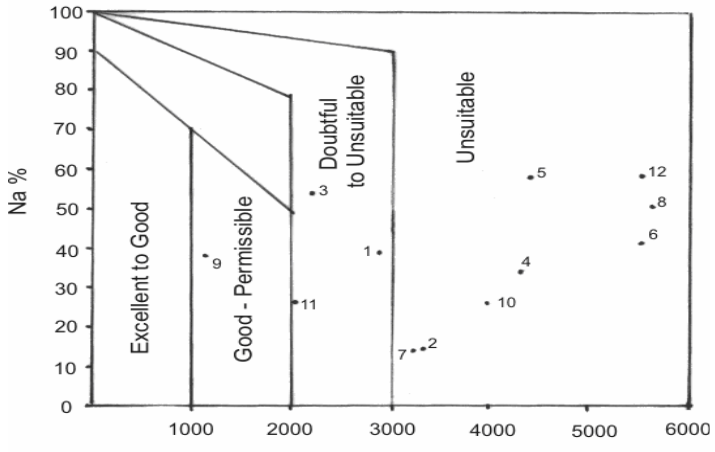


Fig.(5):water classification according to Wilcox(1948)

To evaluate the effect of Na^{+},Ca^{+2},Mg^{+2}ion concentration in irrigation water on the physical properties of the soil,the Sodium Adsorption Ratio is computed from(Herman,1978): SAR=Na/SQRT((Ca + Mg)/2)
Or by evaluating Adjusted SAR(a modification to SAR concept that adds the effect of carbonate and bicarbonate to the older SAR)using the equation explained by(Ayers&Branson,1975): Adj.SAR=SAR[1+(8.4 – pHc)]
pHc is a function of the(Ca+Mg+Na),(Ca+Mg),(HCO3+CO3).The result of SAR and Adj.SAR table(6)were larger than(1.0)indicating the ability of the irrigated water to dissolve the lime with in the soil through its lateral movement with(AL-Ciblak&Ammar,1998).

Table(6):SAR and Adj. SAR values of the water samples

Well No.	SAR	Adjusted SAR
1	4.29	10.37
2	1.44	3.47
3	6.14	14.12
4	3.33	7.45
5	6.86	17.84
6	6.06	11.76
7	1.10	3.05
8	8.01	17.63
9	2.73	6.21
10	2.16	5.55
11	1.83	4.31

To evaluate the tolerance of agricultural crops to such type of waters,the relation between the salinity (mg / l)and the chloride index(rCl / rSO_4) (Soifer,1987)has been drawn as shown in fig.(6)and found that(50%)of the samples are suitable to be used by crops and plants has the ability to salt tolerance in areas of medium to coarse grained sandy soil under a well designed drainage system,while(20%)of the samples are suitable for all type of crops and soils and the other samples are unsuitable for irrigation and agriculture.

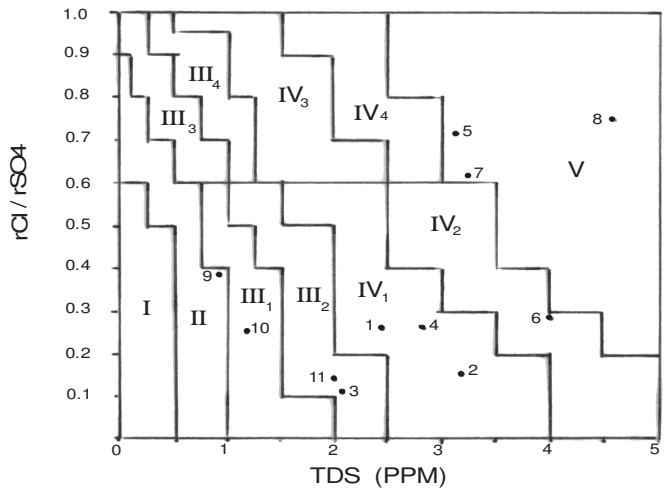


Fig.(6): The Soifer (1987) classification for the water samples

Conclusions

The groundwater within the plain is interpreted using different hydrogeochemical classifications and drawings; The water is of meteoric origin , brackish type as the amount of the total dissolved solids ranges between(1000–4500),with high PH values indicating alkaline reaction conditions,and with respect to the amount of total hardness,the water is very hard.The concentration of the major cations and anions depends on the rock mineralogy that the water encounters and flows through them.The major anion concentration is the sulphate(SO_4^{-2})ion which is derived from dissolution of gypsum and salt lenses characterizing the Pliocene fluvial sediments within the area.However,the dominated cation is either sodium ion or calcium ionThe carbonate rocks maintains the Ca^{+2}&Mg^{+2} ions in the water while the clay lenses provide the water with Na^{+}ion and consume Ca^{+2} ion through the cation exchange processes,So the groundwater is classified as Sulphate group with three families,(Na_2SO_4),($CaSO_4$)and ($MgSO_4$)family having Na>Ca>Mg-SO_4>Cl>HCO_3 or Ca>Mg>Na-SO_4>

$Cl>HCO_3$ type.The possible existence of(Na_2SO_4,$CaSO_4$,$MgSO_4$)salts indicates the semi confined condition of the aquifer system,and existence of $MgCl_2$ salt and the absence of $CaCl_2$ confirm the mixing state of the meteoric water with the deep groundwater.Finally,the water is not recommended for drinking purpose,and it might be recommended for most of animal use.Accordingly,the samples were fall in the limits of(Doubtful to Unsuitable water for irrigation)due to the high salt concentration in conjunction with the medium to high sodium percentage,and the most of the samples are suitable to be used by crops and plants that has the ability to salt tolerance in areas of medium to coarse grained sandy soil under a well designed drainage system.

References

- Al-Chiblak, M.andAmmar, A.(1998) : Application Hydrogeology, University of Omar Almukhtar,661p.
- Ayers,R.s. and Branson,(1977):Quality of water for irrigation,Jour.of the Irrigation and Drainage Division,Vol.103,p.135-142.
- Ayers, R. S. and Westcot, D. W., (1976) : Water Quality for Agricultural, FAO, Rome,97p.
- Buday,T. and Jassim,S.Z.(1987):The regional geology of Iraq**,**Vol.2, Tectonism,Magmatism,and Metamorphism,Baghdad.
- Collins,A.G.(1975):Geochemistry of Oil Field Water,Development in Petroleum science-1,Elsevier,Amsterdam,Holland,496p.
- Edmunds,W. and Walton,N.(1980):A geochemical and isotopic approach to recharge evaluation in semi-arid zones , Arid-zone Hydrology,Panel proceeding Series 6-9/11/1987,St1/Pub/547, IAEA, Vienna.
- Gorell,A.A.,(1958):Classification of formation water based on NaCl content,Am.Assoc.Petroleum Geologist Bull.,Vol.42,2513p.
- Hassan, A.H., Al-Din, T.S. and Al-Sayab, A., (1988) : The(SS) hydrochemical model,Ids,Science College,Baghdad Uni.,Vol.29.
- Hassan,A.H. and Musa,A.(1983):A modified standard for ground water for drinking in Iraq,GAWRR,Vol.2,pp.61-67.

- Hem, J.D., (1989) : Study and interpretation of the chemical characteristics of natural waters,USGS,Water supply paper,3rd ed., Washington D.C.
- Herman, B.(1978) : Ground Water Hydrogeology, McGraw Hill-Kogakusha LTD.,312p.
- Malcolm,R. and Soulsby,C.(2001):Hydrogeochemistry of ground water in coastal wetlands,implications for coastal conservation in Scotland. Sci.total Env.,265, 269p.
- Schoellers,H.(1962):Les souterraines,hydyologie dynamique et evaluation des resources,Masson and C.,Paris,642p.
- Somay, A. and Filiz, S.,(2003) : Hydrology, Hydrogeology and Hydrochemistry of Wetlands,a case study in Izmir Bird Paradise, Turkey Env.geology(43).pp.825-835.
- Soifer , S. Y., (1987) : Irrigation water quality requirements, Gour. Water International, pp.15-18.
- Sirinivasa Rao,Y.,Reddy,T.and Nayudu,P.(1997):Ground water quality in the Niva river basin,Chittoor district,Andhra Pradesh,India Envir. Geology,Vol.32, pp.56-63.
- Todd,D.K.,(1980):Ground Water Hydrology,J.Wiley&Sons.,New York.
- Walton, W.G.,(1970) : Ground Water Resources Evaluation, McGraw Hill int.Book Co.,New York,664p.
- W.H.O.,(1993):International Standards for Drinking Water,World Health Organization,3rd edt., Geneva,Switzerland,36p.
- Wilcox,L.V.(1948):The Quality of water for irrigation use,Tech.Bull. 962,U.S. Dept.of Agricultural,Washington,D.C.

Journal of Kirkuk University – Scientific Studies , vol.3, No.2,2008

الخصائص الهيدروجيوكيميائية لأبارمختارة في سهل الحويجة(جنوب غرب كركوك)

سوران نهاد صادق
كلية العلوم - جامعة كركوك

الخلاصة

تمت دراسة الخصائص الهيدروكيميائية لعدد من الآبار المختارة في منطقة سهل الحويجة إذ أجريت التحاليل الكيميائية لنماذج مياه هذه الآبار وشملت تحليل عدد من الايونات الموجبة والسالبة والمتمثلة بايونات الصوديوم والبوتاسيوم والكالسيوم والمغنيسيوم والكلوريدات والكبريتات والبيكاربونات فضلا عن قياس وحساب الصفات الفيزيائية والدلائل الهيدروكيميائية والتي شملت العسرة الكلية والتوصلية الكهربائية والدالة الحامضية .أظهرت نتائج التحليل بأن مياه هذه الآبار هي قاعدية تقريبا(alkaline)حيث تراوحت قيمها بين(٧,٦-٨,٢)وان العسرة الكلية لها كانت مرتفعة إذ وصل معدلها إلى(1255ppm)كما كانت معدلات القيمة الكلية للأملاح الذائبة عالية أيضا إذوصلت إلى(2900ppm)ممايدلل بان مياه هذه الآبارهومن النوع المختلط(brackish hwater).أن الانيون السائد في مياه هذه الآبار هي الكبريتات(sulphate)بينما كان الكاتيون السائد هو مزيج بين الصوديوم والبوتاسيوم وعن ذلك فان نوع هذه المياه هو(mixed cation-sulphate)بسبب تأثير تواجد والتعريةالكيميائية لصخور التكاوين الجيولوجية الحاوية على معادن الجبس والانهايدرايت وكذلك عمليات التبادل الأيوني والتي تكون مصدرا لهذه الايونات في مياه الآبار.نتائج التحليل الكيميائي للنماذج تظهر بأنها من مجموعة الكبريتات (Sulphate group)وتحوي علىثلاثة عوائل وهي عائلة(Na-SO4 $^{--}$family)وعائلة(Ca-SO4 $^{--}$ family) وعائلة(Mg -SO4 $^{--}$family)مع سيادة نوع

Na>Ca>Mg -- SO4>Cl>HCO3
Ca>Mg>Na -- SO4>Cl>HCO3

أظهرت النتائج أيضا بان مياه هذه الآبار هي غيرصالحة للشرب والري بسبب الملوحة العالية فيهامع ملائمتها للاستخدام للزراعة في الترب الرملية الخشنةوالمتوسطةوتحت ظروف بزل جيدةوهي ملائمة لزراعةالمحاصيل الحقلية ذات المقاومة الملحية العالية والمتوسطة.