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

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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\textsubscript{4}) group having three families which are(Na\textsubscript{2}SO\textsubscript{4}) family with Na\textsuperscript{+}>Ca\textsuperscript{2+}>Mg\textsuperscript{2+}-SO\textsubscript{4}≤\textsuperscript{2}>Cl\textsuperscript{-}>HCO\textsubscript{3},and(CaSO\textsubscript{4})water familyCa\textsuperscript{2+}>Mg\textsuperscript{2+}>Na\textsuperscript{+}-SO\textsubscript{4}≤\textsuperscript{2}>Cl\textsuperscript{-}>HCO\textsubscript{3}≤, and ( MgSO\textsubscript{4} ) family with Mg\textsuperscript{2+} > Na\textsuperscript{+} > Ca\textsuperscript{2+}-SO\textsubscript{4}≤\textsuperscript{2} > Cl\textsuperscript{-} > HCO\textsubscript{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°.4-35°.65)and longitude (43°.47-43°.87),the total area of the catchment area of the plain is about (165)Km\textsuperscript{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 groundwater within the plain as well as its validity for different uses.

![Fig. (1): Location map of the studied area](image)

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

| Property          | Min. | Max. | Av. |
|-------------------|------|------|-----|
| Temperature (°C)  | -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 diminishes outward. The depth to groundwater increases from below of (10 m.) to over (30 m.) 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⁺,  | Atomic absorption spectrophotometer.                               |
| Ca++, Mg++ | Type (Hitachi–180–30)                                              |
| SO₄, Cl⁻  | Spectrophotometer Double Beam.                                     |
| HCO₃⁻, NO₃⁻| 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 than 10%, 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. mhos/cm | PH | Ca ppm | Mg ppm | Na ppm | K ppm | Cl ppm | SO\(_4\) ppm | HCO\(_3\) ppm | 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     | 12.79    | 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 (2830 mg/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\(^{-}\), SO\(_4\)\(^{-2}\), HCO\(_3\)\(^{-}\) 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 sodium 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.

Using (Hassan et al., 1988) technique for classification purposes table (4), 90% of the samples are of (Sulphate Group) having three families which are: (Na₂SO₄) family, comprises 55% of the samples in which the cation sequence is Na⁺ > Ca²⁺ > Mg²⁺ and the anion sequence is SO₄²⁻ > Cl⁻ > HCO₃⁻ where Na⁺ + K⁺ > Cl⁻ and (CaSO₄) water family (35% of the samples) with cation sequence Ca²⁺ > Mg²⁺ > Na⁺ and the anion sequence is SO₄²⁻ > Cl⁻ > HCO₃⁻ where Na⁺ + K⁺ > Cl⁻ and finally (MgSO₄) family with cation sequence g²⁺ > Na⁺ > Ca²⁺ and the anion sequence is SO₄²⁻ > Cl⁻ > HCO₃⁻. 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 SO₄-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-SO₄ | Na>Ca>Mg-SO₄>Cl>HCO₃ | MgSO₄(26.5),CaSO₄(26.4),Na₂SO₄(20.3),NaCl(18.7),Ca(HCO₃)₂(7.6),KCl(2.0) |
| 2       | Sulphate | Ca-SO₄ | Ca>Mg>Na-SO₄>Cl>HCO₃ | CaSO₄(38.8),MgSO₄(38.5),NaCl(11.8),Ca(HCO₃)₂(7.4),Na₂SO₄(2.9),KCl(0.5) |
| 3       | Sulphate | Na-SO₄ | Na>Ca>Mg-SO₄>Cl>HCO₃ | Na₂SO₄(44.8),MgSO₄(21.6),CaSO₄(15.8),Ca(HCO₃)₂(8.2),NaCl(7.4),KCl(2.0) |
| 4       | Sulphate | Mg-SO₄ | Mg>Na>Ca-SO₄>Cl>HCO₃ | MgSO₄(59.8),NaCl(17.8),Na₂SO₄(14.9),Ca(HCO₃)₂(3.87),KCl(2.0),CaSO₄(1.5) |
| 5       | Sulphate | Na-SO₄ | Na>Ca>Mg-SO₄>Cl>HCO₃ | NaCl(34.1),Na₂SO₄(23.6),Ca(HCO₃)₂(16.0),CaSO₄(13.9),MgSO₄(11.4),KCl(0.8) |
| 6       | Sulphate | Na-SO₄ | Na>Ca>Mg-SO₄>Cl>HCO₃ | CaSO₄(33.3),MgSO₄(22.8),NaCl(22.0),Na₂SO₄(19.0),Ca(HCO₃)₂(1.9),KCl(0.8) |
| 7       | Sulphate | Ca-SO₄ | Ca>Mg>Na-SO₄>Cl>HCO₃ | CaSO₄(35.2),Ca(HCO₃)₂(26.7),NaCl(14.0),MgCl(13.2),MgSO₄(10.4),KCl(0.2) |
| 8       | Sulphate | Na-SO₄ | Na>Ca>Mg-SO₄>Cl>HCO₃ | NaCl(40.7),MgSO₄(24.5),CaSO₄(21.4),Na₂SO₄(9.6),Ca(HCO₃)₂(3.0),KCl(0.6) |
| 9       | Sulphate | Na-SO₄ | Na>Ca>Mg-SO₄>Cl>HCO₃ | MgSO₄(26.0),NaCl(21.7),Ca(HCO₃)₂(19.4),Na₂SO₄(16.3),CaSO₄(16.0),KCl(0.3) |
| 10      | Chloride | Ca-Cl | Ca>Na>Mg-SO₄>Cl>HCO₃ | MgSO₄(26.5),CaSO₄(26.4),Na₂SO₄(20.3),NaCl(18.7),Ca(HCO₃)₂(7.6),KCl(2.0) |
| 11      | Sulphate | Ca-SO₄ | Ca>Mg>Na-SO₄>Cl>HCO₃ | MgSO₄(26.5),CaSO₄(26.4),Na₂SO₄(20.3),NaCl(18.7),Ca(HCO₃)₂(7.6),KCl(2.0) |

Hypothetical salt combination has been calculated for the samples (meq %) and the result shows the possible existence of (Na₂SO₄, CaSO₄, MgSO₄) 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 CaCl₂ 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 Ca²⁺ ions and increase the Na⁺ ions in the aquifer water (Hounslow, A., 1995). Comparing SO₄²⁻ with Ca²⁺ ion concentration assume that the primary sources of these ions are gypsum or anhydrite dissolution, only sample No. (10) showed that Ca²⁺ exceeds SO₄²⁻ ions indicating that there is another source for Ca²⁺, which is may be carbonate or silicate, the other water
samples has $\text{SO}_4^{2-} > \text{Ca}^{2+}$ which indicate the removal of $\text{Ca}^{2+}$ by either ion exchange or Calcite precipitation. By inspecting the relationship between non-gypsum $\text{Ca}^{2+}$ (i.e. $\text{Ca}^{2+}$-$\text{SO}_4^{2-}$) and non-halite $\text{Na}^+$ (i.e. $[\text{Na+K}]^+$-$\text{Cl}^-$) 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 $\text{Ca}^{2+}$ increases with decreasing non-halite $\text{Na}^+$. 

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 $\text{Mg}^{2+}$ with $\text{Ca}^{2+}$ 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
Hydrochemical Indicators

The ionic ratios \( r_{Na/Cl}, r_{SO_4/Cl}, (r_{Na-Cl}/r_{SO_4}) \) and \( r_{Ca/Mg} \) were calculated for the water samples (table 5) and their values were ranging between \( 1.16-2.04, 1.4-8.6, 0.05-0.76 \) and \( 1.0-2.99 \) respectively. Accordingly, as \( r_{Na/Cl} > 1 \), then the origin of the groundwater is designated as meteoric water, while the increase in the value of \( r_{Na/Cl} \) and \( r_{SO_4/Cl} \) decrease in the ratio \( (r_{Na-Cl}/r_{SO_4}) \) represent the effect of water of continental origin which is mixed with the original marine water in the natural system continuously.

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

| Well No | Ionic Ratio |
|---------|-------------|
|         | r_{Na/Cl}  | r_{SO_4/Cl} | r_{Na-Cl}/r_{SO_4} | r_{Ca/Mg} |
| 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)](image)

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):

\[
\text{SAR} = \frac{\text{Na}}{\sqrt{\frac{\text{Ca} + \text{Mg}}{2}}}
\]

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):

\[
\text{Adj. SAR} = \text{SAR} \left[ 1 + (8.4 - \text{pHc}) \right]
\]

pHc is a function of the (Ca + Mg + Na), (Ca + Mg), (HCO\(_3\) + CO\(_3\)). 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 within the soil through its lateral movement with (AL-Ciblak & Ammar, 1998).

Table (6): SAR and Adjusted 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 (\( r_{Cl} / r_{SO_4} \)) (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](image)

**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 ion. The 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\(_2 SO_4\)), (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$_2$SO$_4$, 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.

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الخصائص الهيدروجيوكيميائية لأبار مختارة في سهل الحويجة (جنوب غرب كركوك)

سرعان نهاد صادق
كلية العلوم - جامعة كركوك

الخلاصة

تمت دراسة الخصائص الهيدروجيوكيميائية لعدد من الأبار المختارة في منطقة سهل الحويجة إذ أجريت التحليل الكيميائي لانماذج مياه هذه الأبار وشملت تحليل عدد من الأيونات الموجبة والسالبة والمتمثلة بايونات الصوديوم والبوتاسيوم والكالسيوم والمغنيسيوم والكلوريدات والكربونات والبيكاربونات فضلاً عن قياس وحساب الصفات الفيزيائية والدلالات الهيدروجيوكيميائية والتي شملت العسرة الكلية والتصولية الكربوناتية والدالة الحامضية. أظهرت نتائج التحليل بأن مياه هذه الأبار هي قاعدية تقريباً (alkaline) حيث تراوحت قيمها بين (7.2-8.2). إن العسرة الكلية لها كانت مرتفعة إذ وصل مداها إلى (1255ppm) كما كانت معدلات القيمة الكلية للأملاح الذائبة عالية أيضاً إذ وصلت إلى (2900ppm). المدار بين مياه هذه الأبار هو مزيج بين الصوديوم والبوتاسيوم، بينما كان الكاتيون السائد هو مزيج بين الصوديوم والبوتاسيوم وعن ذلك فإن نوع هذه المياه هو مخلوط بين المعادن들의 الصوديوم والمغنيسيوم والمكسيموم. تعود لأسباب تواجد وتعريض هذه المياه لصخور التكاين الجيولوجية الحاوية على معادن الجبس والانهيدريدات وكذلك عمليات التبادل الأيوني والتي تكون مصدرًا لهذه الأيونات في مياه الأبار. نتائج التحليل الكيميائي للنماذج تظهر بأنها من مجموعة الكريستالات (Ca-SO4, Mg-SO4, Na-SO4) والمخلوطات بينها (mixed cation-sulphate). تشير هذه النتائج أيضاً إلى أن مياه هذه الأبار هي غير صالحة للشرب والزراعي بسبب الملوحة والملوثات. استخدمت النتائج أيضاً لمد مياه هذه الأبار لإرشادات الزراعة في التربة الرملية الخشنة المتوسطة حيث تزدهر بيئة ملائمة لزراعة المحاصيل الحقلية ذات المقاومة الملحية العالية والمنخفضة.