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The Effects of Rain Water Percolation through the Fractures on the Petroleum Quality, Hemrin Oilfield, Northern Iraq

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ABSTRACT

The present study suggests that this variation resulted by percolation of rain water through the fractures present in Hemrin anticline, which lead to devastation of petroleum quality. For this reason, this study highlights the hydrogeochemistry of tertiary reservoir formation water as a result percolation of surface waters. The formation water under study are mixed origin from meteoric and marine water, associated with open system reservoir, influenced by percolation of surface water and as bad zone for preservation of hydrocarbon accumulations especially in Albufudhul and some parts of Nukhaila domes, but Allas dome recognized as semi closed system, that a good zone for hydrocarbon accumulations. Formation water differs in hydrochemical system, chemical composition and salinity ranging between 59118-7430mg/l. The hydrogeochemical study suggests that the tertiary formation water is Na-SO_4-chloride type changed to Na-Ca-chloride type reflecting different hydrodynamic system in the field. According to piper classification, formation water samples are fall in the class (g) which represents alkaline water with prevailing sulfate and chloride. The hydrochemical parameters, salinity and their distribution maps were utilized to determine the hydrodynamic zones and percolation flow path to formation water from Albufudhul dome, toward Allas dome that differ in properties on other domes.

Keywords: Formation water; Salinity variation; Hemrin oilfield, Hydrochemical ratios

1. INTRODUCTION

The hydrogeochemistry of formation water was studied to identify formation water origin and to determine its quality. Formation water is natural water presents in pores and holes of the reservoir rocks before water injection to maintain the reservoir pressure (Collins, 1975).

Evsan (2013), studied the geological controls on formation water salinity distribution in southeastern greater natural buttes oil field in Uinta/ USA, they found that the vertical and lateral variation of salinity in the reservoir, controlled stratigraphically by horizontal layering and continuity of different petrophysical rock types, and structurally by faulting and fracture systems.

Formation water has become a vital issue in scientific studies of oil, starting from exploration, drilling, field development and production. It characterizes by special specification greatly differ in terms of chemical composition from surface water (rivers, sea, and lakes), (Hussein, 2013**).** These waters plays substantial role in the geological processes oil reservoirs, such as mineralization, migration and accumulation of hydrocarbons, the variations of pore water salinity and ionic concentrations give an idea to conclude the flow path and potential diagenetic reactivity (Xie, et al., 2003a), the evolution of formation water is not always clear, especially in abnormally pressured environments (Xie, et al., 2003b).

These waters can be classified into three groups based on the variations in its source and composition. The three groups generally identified as meteoric water, connate water and mixed water. The presence of carbonate, bicarbonate, and sulphate in formation water suggest that at least some of the water had probably come from the surface (Georgie, et al., 2001). Formation water analysis that contain chloride and sulphate, carbonate - bicarbonate are meteoric connate mixed that may occur near the present ground surface or may be found below unconformities (Joel, et al, 2010).

The chemical and physical properties of the formation water in the present study play an important role in field development and planning, and quantifying reserves as well as calculations of completion costs including casing and surface equipment costs. Formation water analysis helps operators to estimate expenditure such as the costs of water injection. Finally resistivity of formation water that depends on the salinity represent one of important parameters of computer processed interpretation of the logs that used in static and dynamic modeling of the reservoir.

The study aimed to assess the hydrochemical specifications of the formation water in Hemrin oilfield. Furthermore, to determine the hydrochemical formulas and then the origin of formation water in field. Finally, to classify the oil production and hydrodynamic zones in the field based on formation water properties.

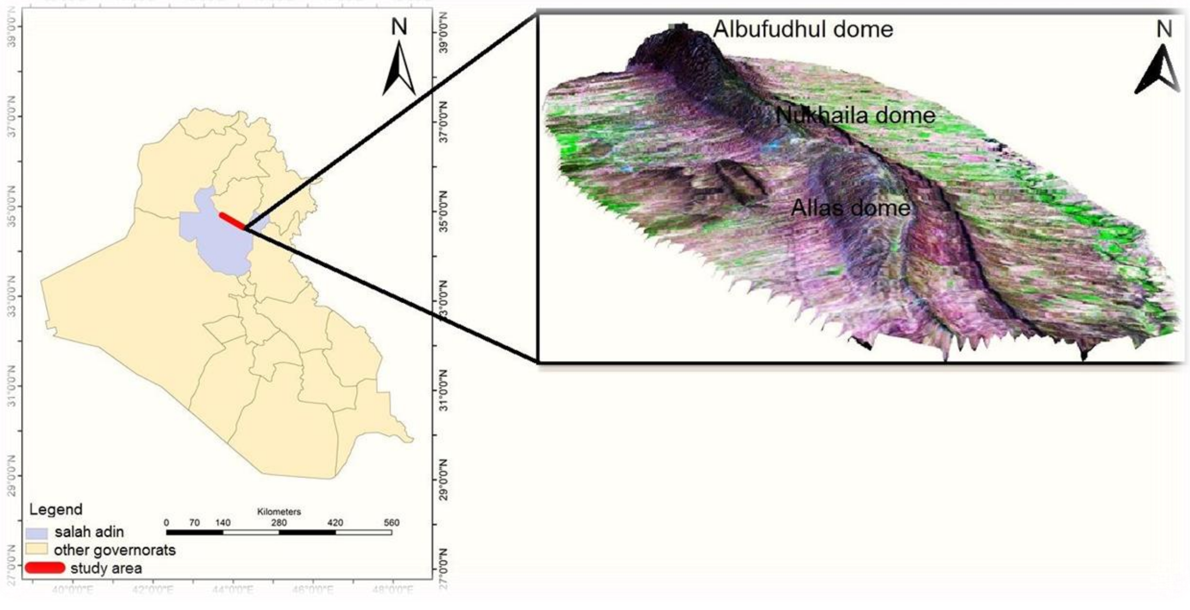

Figure 1: Location of Hemrin oilfield and the three studied domes.

2. MATERIALS AND METHODS

Hemrin oilfield lies within Salahaddin governorate boundary with Kirkuk governorate, approximately 35 km NE Tikrit city and about 80 km to SW Kirkuk city (Figure 1), within the foothill zone, which is part of the unstable shelf of Iraq (Buday and Jassim, 1987). Hemrin north anticline is asymmetrical, doubly plunging anticlines which contains Hemrin oilfield; the southwestern limb is steeper than the northern one (Al Naqib, 1959). This steepening is well displayed by the outer cycles of evaporatic sequence (Lateef, 1975). Tertiary reservoir formations consists mainly recrystallized limestone, with intercalation of thin layers of marl and anhydrite where Fatha formation forms cap rock for Hemrin oilfield. The oilfield consists of three domes (Albufudhul, Nukhaila and Allas) from NW to SE. This field produces the petroleum from main Tertiary reservoirs (Euphrates, Jeribe and Dhiban formations). Formation water analyses of Tertiary reservoir indicator reflect high variety and differences in chemical and physical properties between Albufudhul, Nukhaila, and Allas domes.

The archived data of formation water in north oil company from Tertiary strata in three domes (Albufudhul, Nukhaila and Allas) were processed for the physical and chemical parameters, pH, Total dissolved solid (TDS), major cations (Ca^{+2}, Mg^{+2}, Na^{+}) and anions (SO_4^{-2}, Cl^{-}, HCO_3^{-}). Many methods (which method identify) used to describe the origin and quality of formation water. The present study used many programs for description formation water data such as:

1. GIS 9.3: It is a branch of information technology which deals with different data; it is used to draw the distribution maps of concentration of physiochemical properties of formation water across study area.
2. Rock work 15**:** used to the spread sheet for formation water analysis, and to draw hydrochemical Graphs of formation water.

3. RESULT AND DISCUSSION

3.1. Physical and chemical properties

The results of chemical properties of Tertiary formations water in Hemrin oilfield are listed in (Figures 2, 3, 4, and 5). TDS is very important in reservoir studies because it acts as an important indicator for hydrocarbon exploration (Collins, 1975). Most studies in different oilfield show the inverse proportional between the salinity of formation water and oil types within reservoir whereas the specific gravity of oil decrease during increasing the salinity of formation water (Al Sayyab, 1989). The result of chemical analysis of formation water show high content of TDS (average = 59118). According to classification of Hem (1979), these water can be classified as moderately saline (brackish) to highly saline water (brine) (TDS= 7430-59118). The formation water decreases in (TDS) content toward Albufudhul and Nikhaila dome while show increase towards Allas dome (Figure 2, a). This variation is related to mixing with surface water through percolation of this water into the reservoir that led to dilute the salinity in Albufudhul and Nukhaila domes. The formation water under study according to classification of (Komatina, 2004) shows different water quality, ranging from weakly acidic to alkaline from dome to another (pH=6.75-8.89) (Figure 2, b). This could be a result of the high concentration of HCO_3^{2-}.

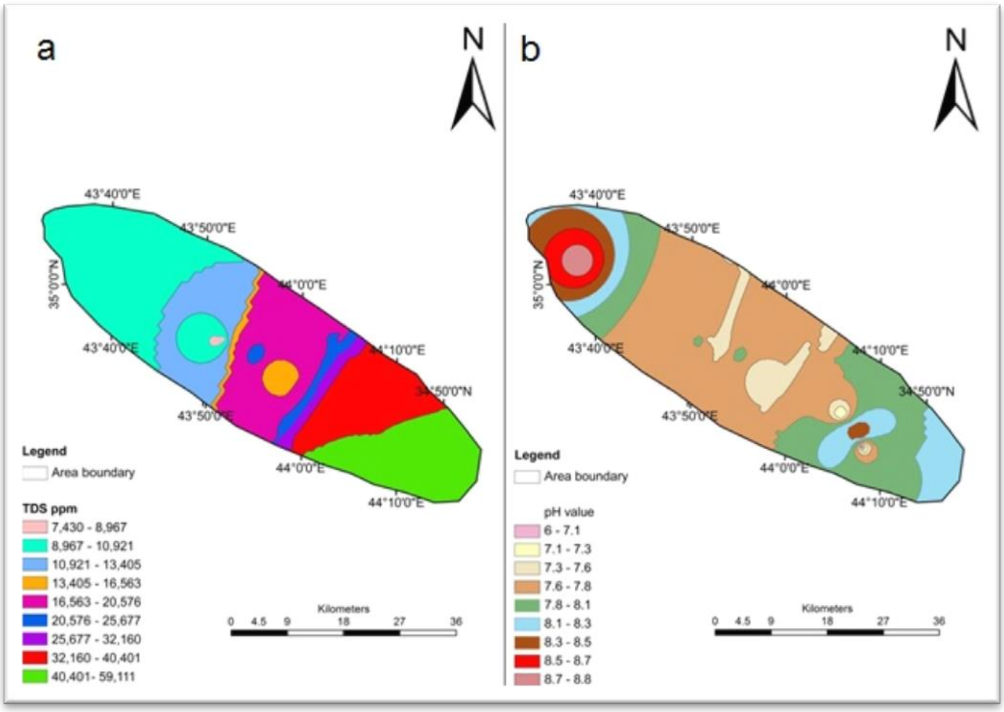

Figure 2: Concentration disruption map in study area (a) TDS ppm, (b) pH value

Major cations and anions including (Na^{+}, Ca^{2+}, Mg^{2+}, Cl^{-}, SO_4^{2-}, HCO_3^{2-}) were analyzed in the present study. The concentration of calcium in the studied formation water of Hemrin oilfield is ranged from 280 to 1840 ppm (Figure 3, a), which does not occur within common range of calcium concentration in formation water. The importance of study of this element is its ability to connect with carbonate and sulfate ions and form different component that affect the porosity and permeability and hinder the movement of fluids within reservoir (Collins, 1975).

Sodium is one of the most abundant ions in formation water, because it's high solubility in water and hard precipitation. It depends on lithology of reservoir, duration of trapping, depth of reservoir and cation exchanging reaction (Collins, 1975). The concentration of sodium in sea water reaches about 10550 ppm (Langmuir, 1997) and more than 40000 ppm in the water of some exampled oilfields in the world (Collins, 1975). The concentration of sodium in studied oilfield is 1489 to 19104 ppm (Figure 3, b). It is less than of sea water (10556 ppm), due to mixing with surface water.

Magnesium is the abundant alkaline earth group element, makes up about 2.1% weight of the earth crust (Collins, 1975). The concentration of Mg in the studied formation water ranged from 48 to 957 ppm (Figure 4, a). This concentration is less than Ca^{2+} and Na^{+} ions; due to the low solubility of dolomite. It is considered among important major ions in formation water because its relationship with formation of dolomite and playing negative or positive role on pore space which increases or reduces porosity through the ability to connect with other ions and form different component that hinder the movement of fluids within reservoir.

The concentration of bicarbonate in Hemrin oilfield is ranges between 431 to 3318 ppm (Figure 4, b). These ions in formation water have negative effects because of formation insoluble salt which closed the pore space in reservoir rocks and effects on the behavior of the reservoir, where it would impede the movement of fluids in the oil reservoirs (Hussein, 2013).

Chloride is the dominant ion having highest concentration in Hemrin oilfield ranged from 1775 to 29998 ppm (Figure 5, a). This high concentration of chloride is due to the ease solubility and difficult adsorption on clay minerals. The concentration of chloride in Hemrin field is less than that of sea water (18980 ppm) (Langmuir, 1997). This indicates that water origin is mixture of connate water with meteoric water.

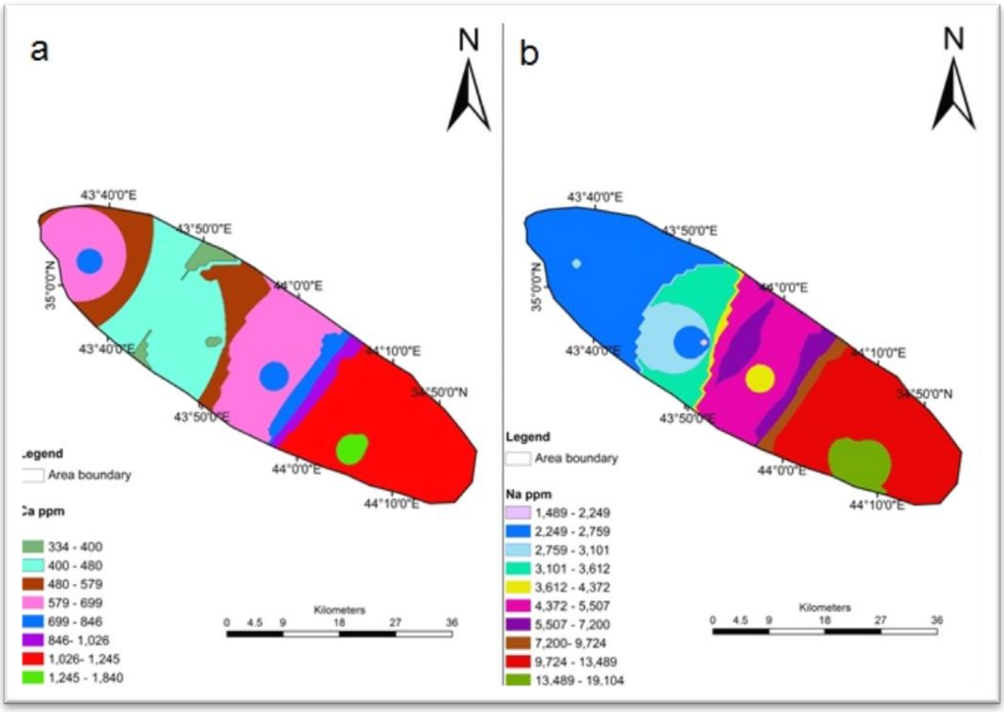

Figure 3: Concentration disruption map in study area (a) Ca ppm, (b) Na ppm

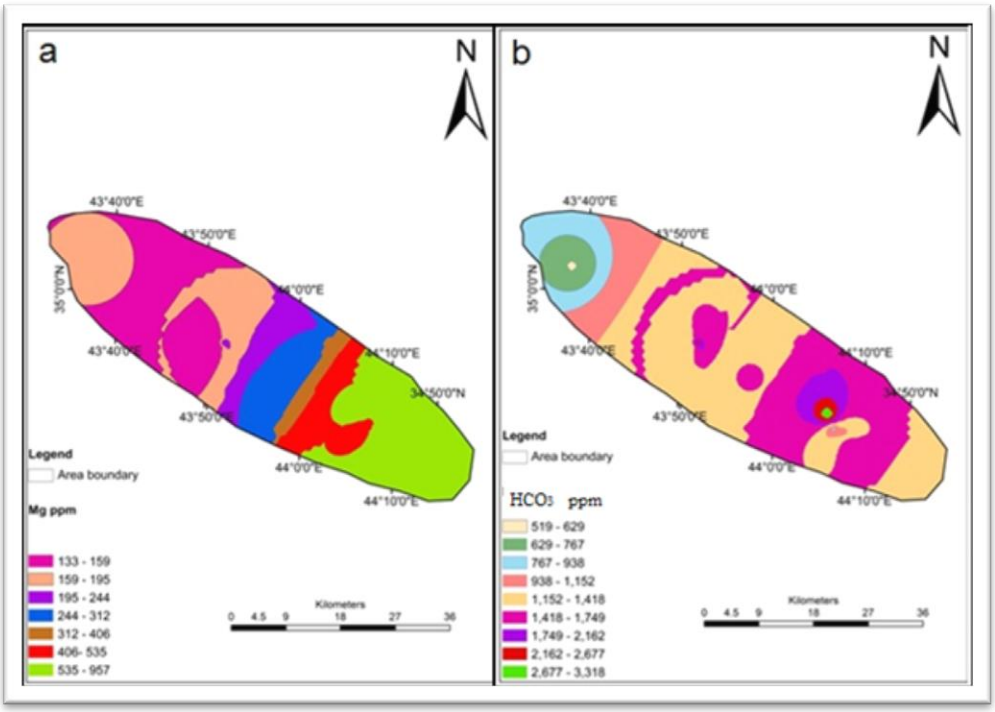

Figure 4: Concentration disruption map in study area (a) Mg ppm, (b) HCO_3 ppm

The concentration of sulfates in the area understudy is ranged from 342 to 6779 ppm (Figure 5, b). The measurement of sulfates in formation water is considered gained greater importance because of the presence of sulfate with other ions such as Strontium and Barium caused in linking it with these ions and forming sulfate sediment which is insoluble concentrate with pores space and hinder the fluid movement within reservoir and caused damage in permeability of reservoir rocks (Al Atabi, 2009). The present of sulfate with sodium and magnesium ions impacts directly the emergence and activity of sulfate reducing bacteria, which causes oxidation of oils and convert them to heavy crudes (Collins, 1975). The concentration of SO_4^{2-} under study is higher than the sea water (900 ppm).

High concentrations of SO_4^{2-} and HCO_3^{2-} in Hemrin oilfield are good indicator on washing of upper layer which consists of the anhydrite, gypsum and carbonate units of Fatha Formation, which exposed in the core of the anticline.

The result of formation water analysis in Hemrin oilfield shows gradual increase in concentration of the chemical and physical properties from Albufudhul dome to Allas dome. This results is an indicator of dilution due to salinity to ward NW (Al bufudhul and Nukhaila domes) through mixing of surface water with formation water. Therefore, these domes are bad zone for accumulation hydrocarbon and product heavy oil. Increasing salinity toward SE effect on decrease of the specific gravity of oil and enhance formation of good zone for accumulation of hydrocarbon and product light oil.

3.2. Hydrochemical Formula

Hydrochemical formula determined according to (Ivanov, 1968). The water type will be known from cations and anions epm%, which are above 15%. Ivanov formula as in below:

$$\text{TDS(mg/l)}\frac{\text{Anions (epm \%) in decreasing order}}{\text{Cataions (epm \%) in decreasing order}}\text{pH}$$

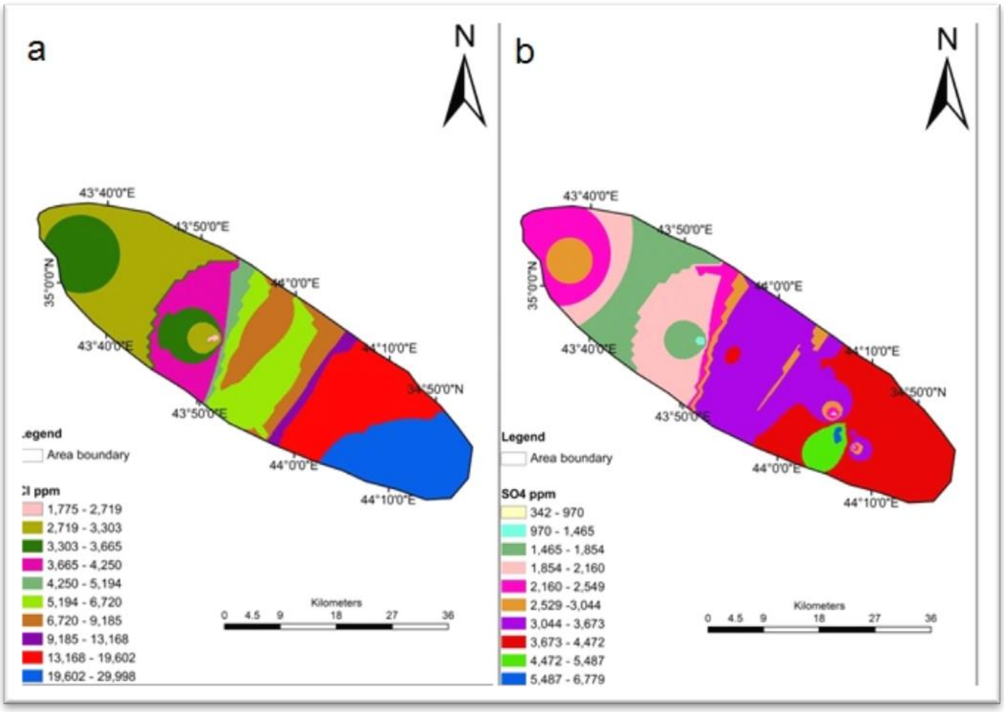

Figure 5: Concentration disruption map in study area (a) Cl ppm, (b) SO_4 ppm

The formation water type in Hemrin oilfield is (Na-SO_4- chloride Type) as in Table 1. Water of the (sulfate-sodium) type, indicating that all of the sodium will react with chloride or sulfate (Bojarski, 1970). The formation water of Hemrin oilfield differs widely from one dome to another in both content of chloride and total load of dissolved mineral matter. It is thought that these variations are caused by physical factors such as the geologic structure, the lenticularity of the beds, and the amount of rainfall. The results of formation water type show prevailing of the Na^+, cations and Cl^-, SO_4^{-2} anions, which were indicators on meteoric connate mixed origin of water within the field. prevailing SO_4-Na water type that reflect the following (a) effect of anhydrite and gypsum units of the Fatha Formation that represent the source of ($SO_4^{=}$), (b) effect of saliferous bed composed mainly of salt bed (NaCl) that may represent the high percent of Na.

3.3. Hydrochymical ratio

Jones (1963) and Ivanov (1968) classified water into two groups, depending on the genetic origin, they are the meteoric water and marine water. The hydrochemical ratio is (rNa/rCl) used as a function for knowing the origin of the formation water. The formation water of marine origin has the value of the ratio less than <1, where the meteoric water is greater than >1. The ratio (rNa/rCl) greater than 0.85 is characterized by active hydrodynamic zone with considerable water movement. It is considered as a zone of little prospect for the preservation of the hydrocarbon deposits (Bojarski, 1970). The results of hydrochemical ratio rNa/rCl that ranged from 0.97 to 1.57, with an average value 1.19 (Figure 6) show mixed meteoric and marine water with increasing in marine origin to ward Allas dome which consider indicator on semi closed system.

The hydrochemical indicator includes salinity (TDS) and ionic ratios (rNa/rCl, rCl/rMg and rCa/rMg) which are used as geochemical methods to determine the area of percolation of the surface water (rain water) to the formation water as well as determining the hydrodynamic zones in Hemrin oilfield. Hydrodynamics is defined as the movement of water in the reservoir interval. Hydrodynamic conditions that affect fluid contacts are usually associated with active meteoric aquifers at relatively shallow depths. Indications of active low salinity meteoric water, high topographic relief, and proximity to recharge areas (Watts, 1987).

According to (Chebotarev, 1955) classification the formation water in Hemrin oilfield found in three hydrodynamic zones .

1. Active exchange zone: The formation water in this zone is influenced by active hydrodynamic movements with flushed out. This zone has low salinity formation water. This zone is represented in Albufudhul dome.
2. Delayed exchange zone: The hydrodynamic flow has low movements and high salinity formation water. This zone is represented in Nukhaila dome.
3. Stagnant condition zone: In this zone the hydrodynamic flow is very low and has very high salinity formation water. This zone is represented in Allas dome.

The formation water salinity increased from recharge area in NW to impermeable area in SE, as well as the increase with the depth and depended on hydraulic gradient (Figure 3, a).The hydrochemical ratios rNa/rCl and rCa/rMg decreased with increasing salinity, while the rCl/rMg increased with the salinity (Chebotarev,1955). The hydrochemical ratio rNa/rCl (Figure 6) and rCa/rMg (Figure 7, a) shows an increase toward NW Hemrin oilfield, and decrease toward SE. The ratio rCl/rMg (Figure 7, b) increased with the increasing salinity toward SE. This hydrochemical ratio are an indicator for percolation flow path to formation water from Albufudhul dome, and low effect from Nukhaila dome, while Allas dome is considered as semi impermeable for percolation of surface water (rain water).

3.4. Classification of formation water

Most of classifications of formation water depend on the dominant mineral ions present in solution. The dissolved components which are used in most classifications depend on quantity major cation (calcium, sodium and magnesium) and major anion (chloride, sulfate and bicarbonate). Piper classification (1946) is used to classify formation water. (Figure 8) shows that the formation water point fall in the lower half of the rhombic from representing water primary salinity. Applying Piper classification on formation water samples of Hemrin oilfield the shows that the formation water samples fall in the class (g) which represents Alkaline water with prevailing sulfate and chloride. Therefore, it is clear that most of the formation water samples in Hemrin oilfield are sulfate- chlorite.

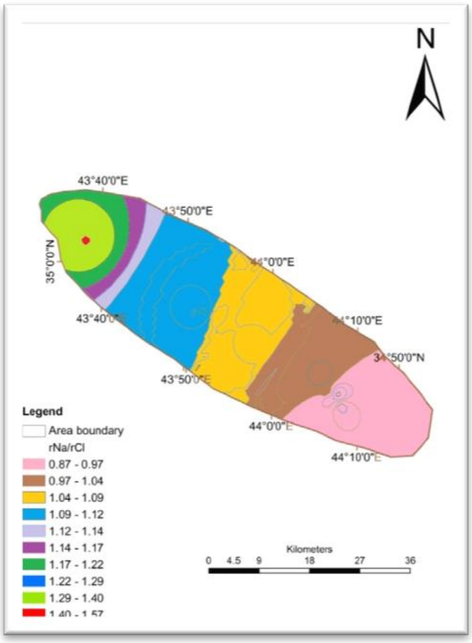

Figure 6: rNa/rCl distribution map in Hemrin oilfield

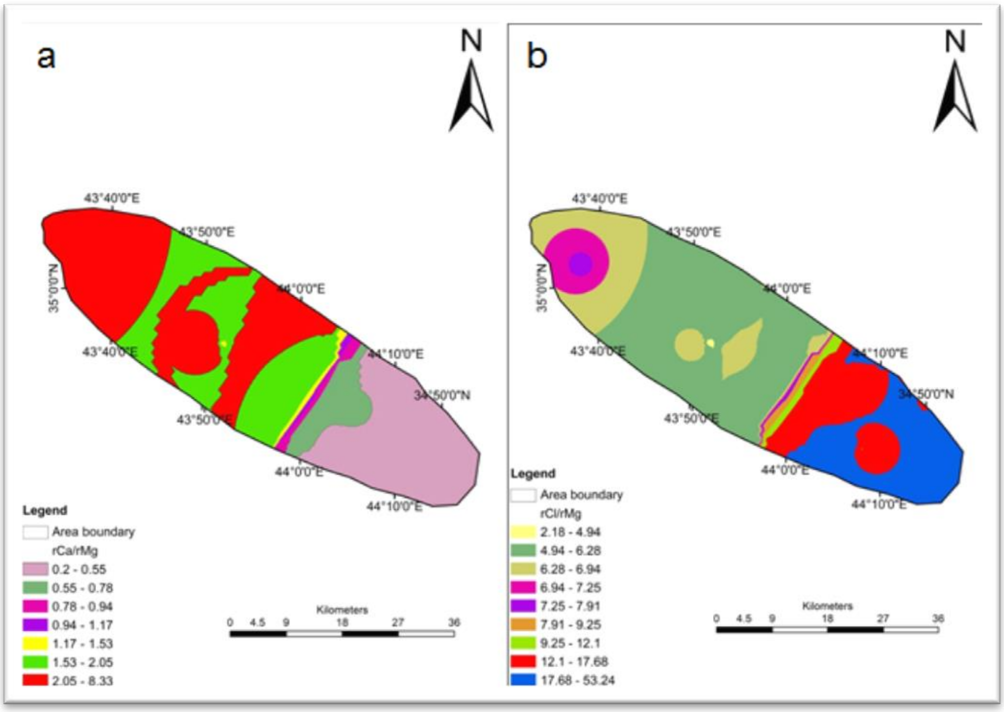

Figure 7: Ratios distribution map in Hemrin oilfield (a) rCa/rMg (b)) rCl/rMg

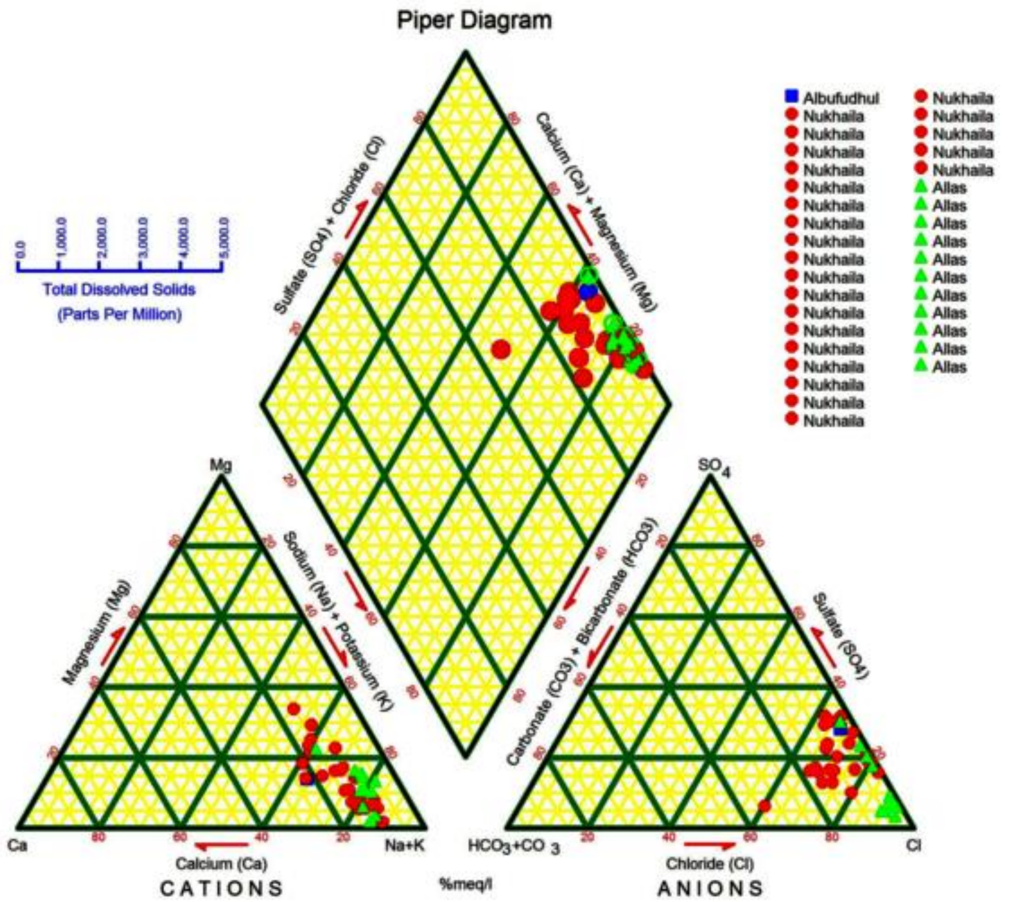

Figure 8: Piper diagram of Formation water in Hemrin oilfield

Table 1: Hydrochemical formula of the formation water in Hamrin oilfield TDS (mg/L)

Dome	Chemical Formula	Water type
Albufudhul	Cl (60.07) SO_4 (33.93) HCO_3 (6) TDS (10832) ———————————— pH (8.83) Na (70.71) Ca (21.12) Mg (8.17)	Na-Ca-SO_4- chloride
Nukhaila	Cl (53.80) SO_4 (37.39) HCO_3 (8.81) TDS (9214) ———————————— pH(8.50) Na (84.73) Ca (12.24) Mg (3.03)	Na-SO_4-chloride
Nukhaila	Cl (54.68) SO_4 (34.44) HCO_3 (10.88) TDS (9175) ———————————— pH (8.62) Na (81.34) Ca (12.44) Mg (6.22)	Na-SO_4-chloride
Nukhaila	Cl (56.33) SO_4 (35.92) HCO_3 (6.74) TDS(8030) ———————————— pH (8.81) Na (83.96) Ca (11.12) Mg (4.82)	Na-SO_4-chloride

Nukhaila	$\frac{\text{Cl (61.22) } HCO_3 \text{ (23.63) } SO_4 \text{ (15.17)}}{\text{Na (67.99) Mg (18.38) Ca (13.63)}}$ TDS (8022) — pH (6.88)	Na-Mg-SO_4-HCO_3-chloride
Nukhaila	$\frac{\text{Cl (64.22) } HCO_3 \text{ (20.31) } SO_4 \text{ (15.47)}}{\text{Na (70.31) Ca (21.34) Mg (8.35)}}$ TDS (8460) — pH (6.95)	Na- Ca-SO_4-HCO_3-chloride
Nukhaila	$\frac{\text{Cl (61.77) } SO_4 \text{ (19.56) } HCO_3 \text{ (18.66)}}{\text{Na(68.49) Ca (20.52) Mg (10.99)}}$ TDS (8219) — pH (7.76)	Na- Ca-HCO_3-SO_4-chloride
Nukhaila	$\frac{\text{Cl (47.61) } HCO_3 \text{ (45.63) } SO_4 \text{ (6.77)}}{\text{Na (61.92) Mg (21.86) Ca (16.22)}}$ TDS (7430) — pH (7.36)	Na-Mg-Ca-HCO_3-chloride
Nukhaila	$\frac{\text{Cl (58.70) } SO_4 \text{ (38.22) } HCO_3 \text{ (3.08)}}{\text{Na (86.19) Ca (10.63) Mg (3.18)}}$ TDS (18009) — pH (8.29)	Na-SO_4-chloride
Nukhaila	$\frac{\text{Cl (73.37) } SO_4 \text{ (23.83) } HCO_3 \text{ (2.79)}}{\text{Na (82.77) Ca (13.05) Mg (4.17)}}$ TDS (24202) — pH (8.09)	Na-SO_4-chloride
Nukhaila	$\frac{\text{Cl (74.72) } SO_4 \text{ (23.52) } HCO_3 \text{ (1.76)}}{\text{Na (84.62) Ca (10.92) Mg (4.46)}}$ TDS (25125) — pH (6.93)	Na-SO_4-chloride
Nukhaila	$\frac{\text{Cl (57.22) } HCO_3 \text{ (22.85) } SO_4 \text{ (19.94)}}{\text{Na (78.16) Ca (11.96) Mg (9.67)}}$ TDS (11878) — pH (7.55)	Na-SO_4-HCO_3-chloride
Nukhaila	$\frac{\text{Cl (55.95) } HCO_3 \text{ (25.37) } SO_4 \text{ (18.68)}}{\text{Na (80.52) Ca (13.37) Mg (6.11)}}$ TDS (12130) — pH (6.91)	Na-SO_4-HCO_3-chloride
Nukhaila	$\frac{\text{Cl (58.64) } HCO_3 \text{ (22.8) } SO_4 \text{ (18.48)}}{\text{Na (78.79) Ca (11.15) Mg (10.06)}}$ TDS (13562) — pH (7.30)	Na-SO_4-HCO_3-chloride
Nukhaila	$\frac{\text{Cl (64.59) } SO_4 \text{ (33.35) } HCO_3 \text{ (2.06)}}{\text{Na (90.49) Ca (8.49) Mg (1.02)}}$ TDS (24957) — pH (8.89)	Na- SO_4-chloride
Nukhaila	$\frac{\text{Cl (71.96) } SO_4 \text{ (25.91) } HCO_3 \text{ (2.13)}}{\text{Na (88.85) Ca (7.96) Mg (3.18)}}$ TDS (31687) — pH (8.67)	Na- SO_4-chloride
Nukhaila	$\frac{\text{Cl (78.44) } SO_4 \text{ (20.20) } HCO_3 \text{ (1.36)}}{\text{Na (87.85) Ca (7.81) Mg (4.34)}}$ TDS (35431) — pH (8.55)	Na- SO_4-chloride

Table 1: Continued

Nukhaila	Cl (69.87) SO_4 (20.54) HCO_3 (9.59) TDS (14960) ——— pH (7.20) Na (82.19) Ca (9.57) Mg (8.25)	Na- SO_4-chloride
Nukhaila	Cl (71.68) HCO_3 (15.90) SO_4 (12.42) TDS (12148) ——— pH (6.92) Na (75.69) Mg (13.73) Ca (10.58)	Na- HCO_3- chloride
Nukhaila	Cl (63.17) SO_4 (19.55) HCO_3 (17.29) TDS (13555) ——— pH (7.50) Na (76.991) Ca (13.44) Mg (9.57)	Na-HCO_3-SO_4-chloride
Nukhaila	Cl (62.55) SO_4 (24.33) HCO_3 (13.13) TDS (12959) ——— pH (7.68) Na (68.90) Ca (15.57) Mg (15.53)	Na-Ca-Mg-SO_4-chloride
Nukhaila	Cl (57.97) SO_4 (28.26) HCO_3 (13.77) TDS (12631) ——— pH (7.35) Na (69.56) Ca (17.32) Mg (13.11)	Na-Ca-SO_4-chloride
Nukhaila	Cl (58.15) SO_4 (26.53) HCO_3 (15.31) TDS (12455) ——— pH (7.36) Na (68.82) Ca (16.85) Mg (14.33)	Na-Ca- HCO_3-SO_4-chloride
Nukhaila	Cl (64.73) SO_4 (29.37) HCO_3 (5.91) TDS (19552) ——— pH (7.50) Na (74.22) Ca (17.09) Mg (8.69)	Na-Ca- SO_4-chloride
Allas	Cl (84.56) HCO_3 (9.16) SO_4 (6.28) TDS (36161) ——— pH (7) Na (83.88) Mg (8.39) Ca (7.74)	Na-chloride
Allas	Cl (85.84) HCO_3 (7.78) SO_4 (6.38) TDS (37235) ——— pH (7.13) Na (83.65) Mg (8.65) Ca (7.40)	Na-chloride
Allas	Cl (59.13) SO_4 (36.35) HCO_3 (4.52) TDS (23729) ——— pH (8.47) Na (87.68) Ca (11.21) Mg (1.11)	Na-SO_4-chloride
Allas	Cl (68.71) SO_4 (29.01) HCO_3 (2.29) TDS (27013) ——— pH (8.21) Na (70.83) Ca (15.51) Mg (13.65)	Na-Ca--SO_4-chloride

Allas	Cl (75.61) SO_4 (22.27) HCO_3 (2.12) TDS (24562) ———————— pH (8.88) Na (85.018) Ca (11.10) Mg (3.42)	Na--SO_4-chloride
Allas	Cl (87.94) SO_4 (8.33) HCO_3 (3.73) TDS (49627) ———————— pH (8.54) Na (81.91) Mg (9.47) Ca (8.62)	Na-chloride
Allas	Cl (89.97) SO_4 (8.05) HCO_3 (1.98) TDS (45490) ———————— pH (8.59) Na (86.83) Ca (7.38) Mg (5.79)	Na-chloride
Allas	Cl (72.34) SO_4 (25.49) HCO_3 (2.17) TDS (35019) ———————— pH (8.67) Na (88.66) Ca (9.37) Mg (1.97)	Na--SO_4-chloride
Allas	Cl (85.82) SO_4 (11.71) HCO_3 (2.47) TDS (56572) ———————— pH (8.04) Na (84.19) Ca (9.83) Mg (5.97)	Na-chloride
Allas	Cl (86.49) SO_4 (11.26) HCO_3 (2.25) TDS (59118) ———————— pH (8.26) Na (84.92) Ca (8.57) Mg (6.51)	Na-chloride
Allas	Cl (90.69) HCO_3 (4.78) SO_4 (4.53) TDS (49172) ———————— pH (6.75) Na (87.14) Mg (7.62) Ca (5.25)	Na-chloride

4. CONCLUSIONS

The formation water of Hemrin oilfield differs widely from one dome to another in both content of chloride and total load of dissolved mineral matter due to physical factors as the geologic structure, the lenticularity of the beds, and the amount of rainfall. The hydrogeochemical study shows the formation water is mixed origin between meteoric water and connate water of very variation salinity from medium salinity has TDS of 7430 mg/l, to brine has TDS of 59118 mg/l. The cations range rNa > rCa > rMg and anions as rCl > rSO4 > rHCO3. prevailing Cl- Na - SO_4 in formation water reflect the following (a) effect of anhydrite and gypsum units of Fatha formation that represent the source of ($SO_4^{=}$), (b) effect of saliferous bed composed mainly of salt bed (NaCl) that may represent the high percent of Cl and Na.

High concentrations of SO_4^{2-} and HCO_3^{2-} in under study are good indicator on washing of the upper layer which consists of the anhydrite, gypsum and carbonate units of Fatha formation, which exposed in the core of the anticline. The water type is Na-SO4-chlorid type, which indicates association with open system reservoir which is influenced by amount of rain fall. This water fall in the class (g) according to piper classification this represents alkaline water with prevailing sulfate and chloride. Hydrochemical ratio (rNa/rCl, rCl/Mg, Ca/rMg), and salinity shows that there are three hydrodynamics zones according to (Chebotarev, 1955) classification, (a) Albufudhul dome that form active exchange zone and reflects active movement of water, (b) Nukhaila dome that form delayed exchange zone and reflects less active movements of water, (c) Allas dome that form stagnant condition zone and reflects impermeable movements of water.

The ratio (rNa/rCl) in under study greater than 0.85 that characterized by active hydrodynamic zone with considerable water movement and considered as a zone of little prospect for the preservation of the hydrocarbon deposits according to (Bojarski, 1970). According to formation water quality, Hemrin oilfield classify tow zone for oil accumulation. Albufudhul and NW saddle of Nukhaila domes is bad zone while SE saddle of Nukhaila and Allas domes considers a good zone so procedures of field development must be in Allas dome.

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