



Analysis of Water Quality using Physical- Chemical Parameters: Case of watershed Sebkhia Oran

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Unfortunately, certain stretches of the watershed are polluted. It has scarce physicochemical data on its water resources that could assist in making robust decision in mitigating the impact of human societies on natural waters; which may not only preserve natural areas, but improve the quality of life of her growing population. In an attempt to study the environmental impact on water quality, an investigation was carried out to monitor the water quality over a period from 04 to 20 July 2011. So fifty samples were collected and analyzed. The water physico-chemistry prior was consistent with that of researches done previously in that area. The average value of different parameters are: pH 6.8, electric conductivity 6,06 (dS/m), chloride 1780 (mg/l), sodium 1811(mg/l), sulfate 631 (mg/l), nitrate 27 (mg/l), magnesium 177 (mg/l), calcium 321 (mg/l) and bicarbonate 327(mg/l).

Higher values of the physical-chemical parameters of water obtained in the present study sites indicate that the results obtained fell within the maximum allowable limit set by the World Health Organization for drinking water.

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Analysis of Water Quality using Physical-Chemical Parameters: Case of watershed Sebkhia Oran

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I. INTRODUCTION

The increasing demand on water, either for the drinkable water supply, or for the agricultural and industrial custom, requires a very thorough hydro-chemical study to protect better and manage this resource.

Here, it is about the pouring watershed sebkhia of Oran, a region characterized by a dry half climate where raises the problem of the salinity and an over-exploitation of subterranean waters.

During this work, we shall limit to give some geological information and hydro chemical of basis with interpretations which can be discussed. This incites us to begin other more thorough studies.

II. MATERIALS AND METHODS

a) Geographical Situation

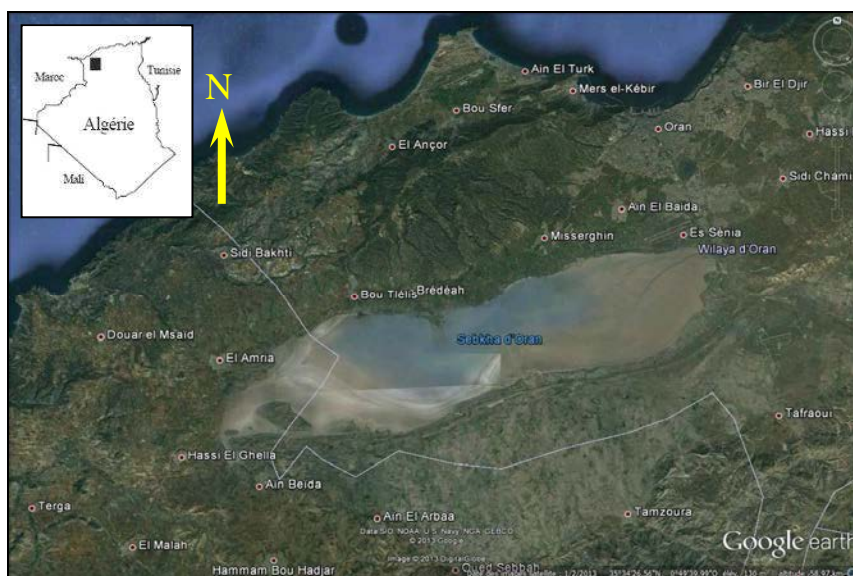


Figure 1 : Demarcation of the Study Zone. (Image Google Earth 2013).

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III. WATER SAMPLING AND MEASUREMENT OF PHYSIC-CHEMICAL PARAMETERS

The various physical-chemical parameters were determined through the techniques listed in the table 1.

Table 1 : Equipment and Methods.

Physic-chemical parameters	Equipment and methods
pH	pH-portable meter, HANNA instrument HI 9811
Electrical conductivity	
Cl ⁻	Volumetric
HCO ₃ ⁻	
Mg ⁺²	
Ca ⁺²	
Na ⁺	Spectro-photometry
SO ₄ ²⁻	Spectrometry
NO ₃ ⁻	

IV. RESULTS

In the present approach, we made an estimation of some physical-chemical parameters of the treatment period and the possible risks of degradation of the quality of waters in the sebkha watershed of Oran (Table 2).

Table 2 : Chemical Composition Averages Waters in the Watershed of Sebkhya of Oran.

	Unit	Average	Min.	Max.	Standard deviation	Median
pH		6,85	5,1	7,6	0,42	6,9
CE	(dS/m)	6,06	0,98	15,82	3,44	6,16
Cl ⁻	(mg/l)	1779,05	130,53	6480,2	1486,22	1625,51
SO ₄ ⁻²		630,47	406	1662	253,11	565,78
Na ⁺		1811,3	297	6853,7	1396,64	1468,14
Ca ⁺²		320,92	183,27	740	123,51	302,91
Mg ⁺²		176,97	98,94	405,14	69,1	166,69
HCO ₃ ⁻		327	152	954	139	313
NO ₃ ⁻		27,4	3	112	24,64	20

V. DISCUSSION

The quality of waters of the region is moderately to enough charged. The values of the electric conductivity spread out of 980 in 15820 μ S / cm. It is important to indicate that this salinity evolves generally in the direction of the ground water flow. It is weak near the recharge areas and a high near the sebkha (Unesco, 1978).

Indeed during the period of low-water mark (period of taking of our sampling), the increase of the temperature favors the evaporation of waters of the surface and the evapotranspiration of subterranean waters, what is often translated by a progressive increase of the salinity of the solutions of the vadose zone (Benziane, 2012).

The most plentiful hydro-chemical facies are of sodium chloride to calcium sulfate type.

It shows the influence of the leaching of the salty grounds and that of the gypsiferous trainings.

Considering the various temporal and spatial values of the chemical elements, the contents, the evolution and the origin of the salinity, we judged with a global statistical analysis to release the big lines of the chemistry of the region.

a) Analysis and Interpretation of Scatter Diagrams Representing the Various Relations between the Chemical Parameters

Two dominant families of water are met in the studied watershed:

- Family of calcium sulfate waters;
- Family of sodium chloride waters.

To explain some existing relations between the chemical elements, certain graphs were represented.

i. *Couple Cl⁻ / SO₄²⁻*

Taking into account the dominance of the chloride and sulfate facies, it is important to verify the relation between these two elements.

The graph shows a dispersal of points indicating a proportional evolution both Elements thus having a common saliferous origin (Figure 3).

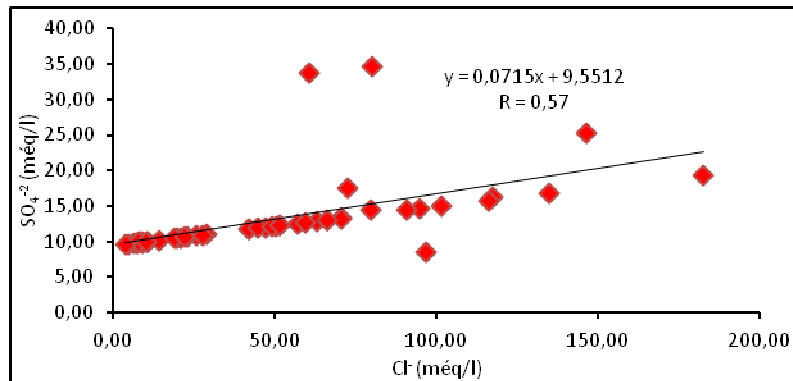


Figure 3 : Relation Cl⁻ - SO₄²⁻

ii. *Cl⁻ / SO₄²⁻ / Conductivity*

The influence of these two elements on the electrical conductivity of the water was verified in the assistant of the graph (Figure 4). We note that the conductivity is influenced by the chlorides that by sulfates.

The representation schedules watch that 80 % of points present a report upper to 1, indicating a dominance of the chloride ions in relation to gypsum. A

dominance of the chloride ions which is understandable by the leaching of gypsiferous-marl grounds, and that the origin of sulfates is especially due to an artificial pollution by fertilizers used in agriculture.

To indicate, that the plains of Boutlélis, Messerghine as well as M'léta present capacities in one intensive agriculture as prove studies of 1974 on capacities agropédologiques of the plain of M'léta.

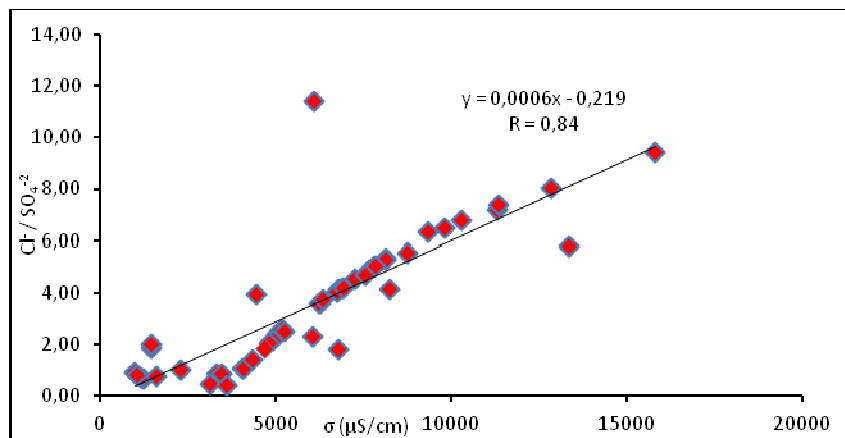


Figure 4 : Relation (Cl⁻ / SO₄²⁻) – Conductivité

iii. *Couple SO₄²⁻ / Mg²⁺*

The examination of this relation shows a proportional evolution of sulfates and magnesium (Figure 5). This relation translates the dissolution of a sulfate of magnesium of saliferous origin.

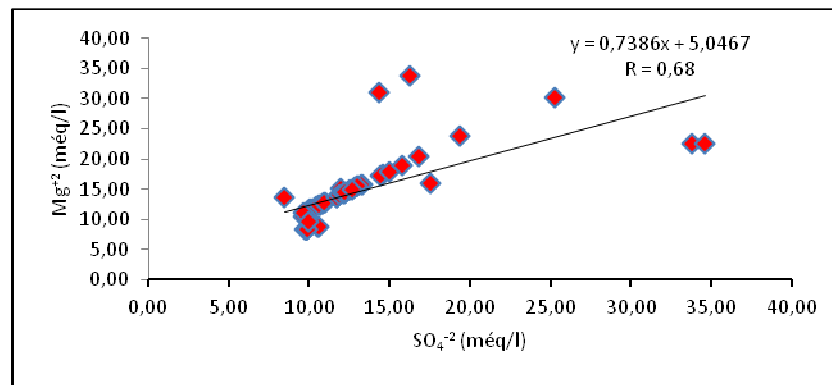


Figure 5 : Relation SO_4^{2-} - Mg^{+2}

iv. Diagram $Ca^{+2} / (HCO_3^- + SO_4^{2-}) - Na^+ / Cl^-$

The studies of ionic exchange in geological formations revealed, that generally, during the process of exchange, one of the ions is very strongly retained against any movement of the other ones. It is a preferential adsorption known by selectivity of ionic exchange (Assa, 1976).

The carrying over of all the water points on the diagram (Figure 6) shows that 84 % of these points have

sudden a basic exchange, 10 % present a deficit in Na^+ and in Ca^{+2} , and 6 % present an excess in Ca^{+2} compared with the ions HCO_3^- and SO_4^{2-} . The excess in Na^+ which comes along by a deficit in Ca^{+2} show the responsibility of the basic exchange in the increase of the contents in Na^+ .

A: Excess in Ca^{+2} , b: Deficit in Na^+ and Ca^{+2} , c: Deficit in Cl^- and in Ca^{+2} : basic exchange.

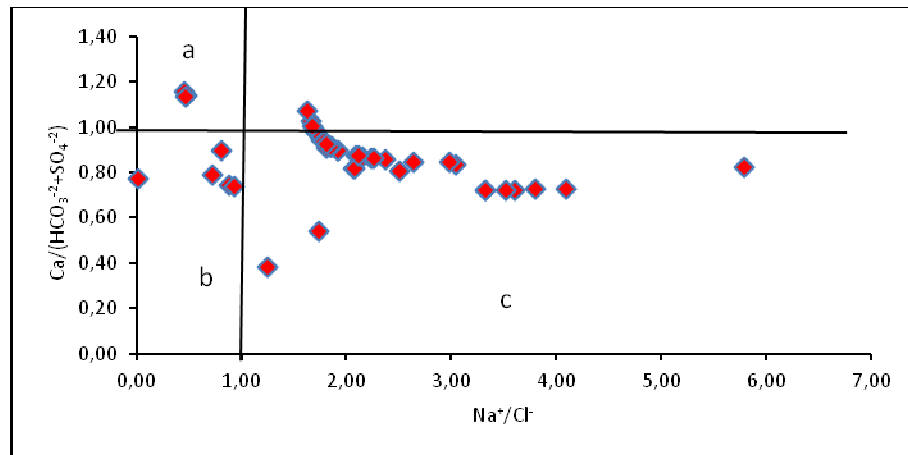


Figure 5 : Basic Exchange

During their subterranean routes, waters come into contact with various formations geological that have the property to exchange their ions for those contained in the waters.

v. Origin of the Calcium

The figure 6 shows the evolution of the calcium according to bicarbonates. The points positioning on the right of slope 1 indicate the origin carbonated of the calcium ions.

However, the other points show an excess of the calcium further to the dissolution of the gypsum.

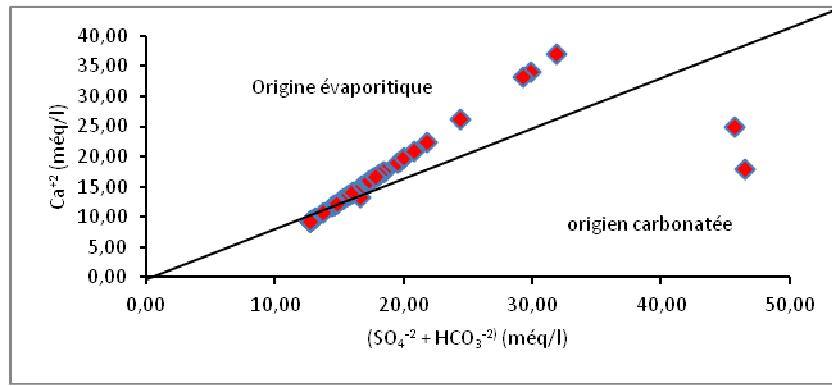


Figure 6 : Evolution of the Calcium.

b) Treatment Statistics of the Data (Principal Components Analysis (P.C.A))

A statistical study in principal components analysis (P.C.A) is made on the matrix of data formed by 9 variables (pH, Conductivity, Ca²⁺, Mg²⁺, Na²⁺, HCO₃⁻, SO₄²⁻, Cl⁻, NO₃⁻) and 50 observations.

The interpretation of the analysis will be made according to the information order given by the software (SPSS V17) (Table 3).

This analysis was pushed up to 3 factors and 99, 65 % of the variance was able to be expressed. Only the first two axes are considered in the description of the correlations between variables.

Table 3 : Correlation between Chemical Elements

Correlation	pH	Conduc	Cl ⁻	SO ₄ ²⁻	Na ²⁺	Ca ²⁺	Mg ²⁺	HCO ₃ ⁻	NO ₃ ⁻
pH	1,000								
Conduc	-,475	1,000							
Cl ⁻	-,338	,942	1,000						
SO ₄ ²⁻	-,094	,504	,568	1,000					
Na ²⁺	-,348	,832	,832	,443	1,000				
Ca ²⁺	-,395	,829	,820	,599	,497	1,000			
Mg ²⁺	-,372	,815	,812	,677	,480	,984	1,000		
HCO ₃ ⁻	-,193	,464	,466	,657	,182	,680	,728	1,000	
NO ₃ ⁻	,254	-,271	-,178	,268	-,169	-,179	-,090	,012	1,000

The analysis of the factorial plan 1-2 shows that more than 59 % of the total variance is expressed. The

analysis in this plan is thus acceptable (Athamena, 2006) (Table 4).

Table 4 : Total Variance Explained.

Component	Total	% of Variance	Cumulative %
1	1,529E7	94,980	94,980
2	543511,891	3,377	98,357
3	208036,263	1,293	99,650

i. A Significant Positive Correlation was Observed between

Cl⁻-Conduc, Na⁺-Conduc, Ca²⁺-Conduc, Mg²⁺-Conduc, Mg²⁺- Cl⁻, Na⁺- Cl⁻, Ca²⁺- Cl⁻, Mg²⁺- Ca²⁺, HCO₃⁻- Mg²⁺.

ii. A Moderately Significant Positive Correlation was Observed between

SO₄²⁻-Conduc, Cl⁻- HCO₃⁻, SO₄²⁻- Cl⁻, Na⁺- SO₄²⁻, and Ca²⁺- SO₄²⁻.

These connections testify of the salty influence on the chemistry water of the region.

The results allow making a first typological approach of the various variables according to their

affinities and their groupings on the first two principal components analysis from their contribution.

The factor 1 represents 97,980% of the variance and it is determined by the chemical elements: the conductivity, Cl⁻, Ca²⁺, Mg²⁺, Na⁺, HCO₃⁻ and SO₄²⁻. This allows us to consider the factor F1 as factor of

mineralization. Associated with evaporates (Ca SO₄, Ca SO₄ 2H₂O, Mg SO₄, Ca Cl, and Mg Cl) (Figure 7).

The factor 2 represents 3,377 % of the variance is strongly determined by bicarbonates HCO₃⁻ and Ca²⁺. It is thus the factor of deep waters of origin (Table 4 and Figure 7).

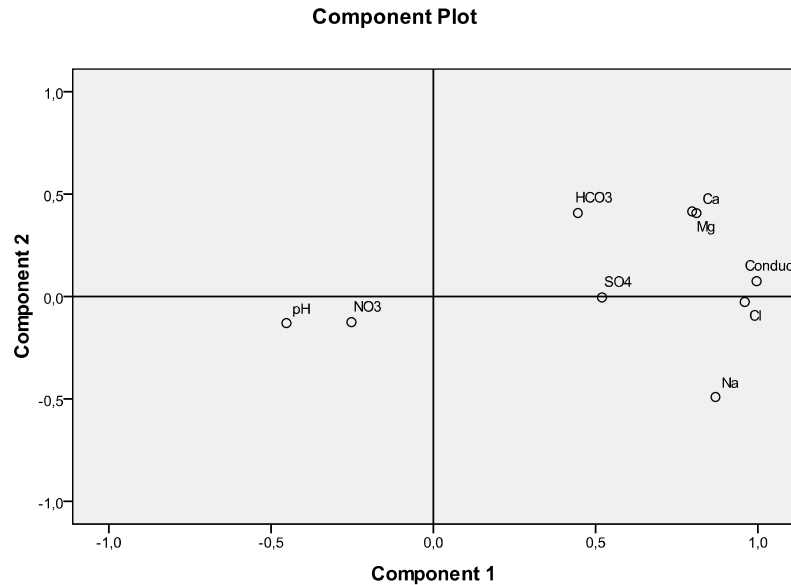


Figure 7: Projection of Variables on the Factorial Plan 1-2.

VI. CONCLUSION

In this first approach of the study of the groundwater inside the studied zone, the quality of the groundwater, in this zone seems to be distorted by sources of superficial pollution. The diversity of the results obtained in the various station makes however difficult the formulation of a quality diagnosis of the valid water for the whole studied sector.

Generally, the analysis of physical-chemical data allowed deducing that in wells protected are placed far from the sources of pollution. The evolution of the chemical elements (Na⁺, Cl⁻, Ca²⁺, SO₄²⁻, HCO₃⁻), who characterize the main geological formations of the watershed, showed the dominance of the saliferous ions (Na⁺, Cl⁻) and gypsiferous ions (Ca²⁺, SO₄²⁻) compared to carbonated (Ca²⁺, HCO₃⁻).

The studied parameters displace these subterranean waters of the usable water to drink.

This shapes well the state envisaged during our period of sampling. The drinkable water supply was satisfied with the water of desalination. Subterranean waters and of surface serves only for the irrigation and the breeding.

This balance assessment also highlighted the phenomenon of basic exchange between the waters of the tablecloth and the clayey passages, the latter was revealed by the increase of the contents in Na⁺ with regard to Cl⁻.

The feasibility of the basic exchanges of Na⁺ - Ca²⁺ or Na⁺ - Mg²⁺, for a low percentage of clay in the carbonated rocks could end in considerable changes of the concentrations in Na⁺, Ca²⁺ and Mg²⁺ in waters salted by basic exchange. Furthermore, it is in connection with the pluviometrical regime, in the intense evaporation, in the pumping, in the irrigation and in the intensive and extensive use of fertilizers.

The causes of pollution of infested water are mainly due to raw waste water circulating in the small canals used to evacuate the waste water or for the irrigation, which infiltrates up to the groundwater. The second cause of pollution would result probably from fertilizer and sometimes from the flow of manure of sheepfolds and from cowsheds.

Fertilizers are leaching from the water which pulls towards the tablecloth bacteria and other soluble substances.

A supervision of the quality of the water of the tablecloth seems obviously desirable, but a more complete analysis of the mechanisms of contamination of the groundwater could be envisaged only by widening the number of samples and the frequency of the takings, as well as the number of moderate parameters (Sullivan, on 1982).

REFERENCES RÉFÉRENCES REFERENCIAS

1. Assa, A. D., 1976. *Phénomène de sélectivité d'échange cationique dans certains minéraux argileux. 1. La sélectivité du potassium dans un système potassium-calcium* Cah. ORSTOM, sér. Pédol., vol. XIV, n° 3, pp. 219-226.
2. Athamena, M., 2006. *Étude des ressources thermales de l'ensemble allochtone sud sétifien*. Thèse de Magister, Université de Batna, 131 p.
3. Benziane, A., Boualla, N. et Derrich, Z., 2012. *Aptitude des eaux du bassin de la Grande Sebkhia d'Oran à l'irrigation* Journal of Applied Biosciences 56: 4066– 4074 ISSN 1997–5902.
4. Ghebouli, M. S., Bencheikh ElHocine, M., 2008. *Origine de la salinité des eaux souterraines cas des hautes plaines sétifiennes (Nord Est Algerien)* Sciences & Technologie A – N°28 Décembre. pp. 37-46.
5. Sullivan, P. J., 1982. *Dilution of municipal Landfill Leachate. Franklin County*. Indiana. J. of Environ. Health. V, (44): 253-257.
6. Unesco, 1978. *International glossary of hydrogeology*, First preliminary edition, Technical documents in hydrology, U.N.E.S.C.O., SC-77/WS/71, Paris, p. 120.



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