



The contribution of PCR for characterization of groundwater in the region Ziban (South-eastern Algeria)

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Abstract

The region of El Ghrous oriented to agricultural purpose, the irrigation in this area is made from water of the Mio-Pliocene aquifer and lower Eocene. Analysis of major elements and nitrates performed on these waters, shows higher concentrations. As an example : Na (> 400 mg / l), Ca (> 723 mg / l), Mg (> 310 mg / l), Cl (> 850 mg / l), SO₄ (> 4000 mg / l) and NO₃ (> 175 mg / l) for the sheet of Miopliocène. As regards to lower Eocene ,we find the following concentrations: Na (> 400 mg / l), Ca (> 700 mg / l), Mg (> 250 mg / l), Cl 1000 mg / l), SO₄ (> 2000mg / l) and NO₃ (<50 mg / l). To determine the apparent links between the chemical elements, we conducted a principal components analysis. The observation of the PCR circle, bring out the mineralization of water caused primarily by chlorides and sulphates on the anions side and all cations (Ca, Mg, Na and K) indicating a similar source. It is less influenced by bicarbonates. Nitrates that are not correlated to any elements seem to have an anthropogenic origin.

Keywords: Groundwater, agro-chemical ,pollution, mineralization, nitrate

1. Introduction :

La Ziban region (arid region) is a source of economic richness and natural diversity. The inspection of agriculture in this area was necessary because it has undergone a broad and deep changes through the various agricultural policies of the state since independence until to day, notably through the implementation of national program of agricultural development in 2000.

Indeed, productivity has increased exponentially in El Ghrous commune (Biskra at South-east of Algeria) and continues to increase involving the creation of a major basin of production for the crops under greenhouses, which there were over 20,000 greenhouses (CRSTRA, 2007) and irrigated areas which are among the largest developed areas in large plots. The escalation of agriculture and intensive application often uncontrolled agro-chemicals (78.94% of farmers use fertilizers and use pesticides 68.42 in their plots) threat to day , the water resources in this region.

Water pollution from agriculture source is loosely associated with nitrates or phosphates. International standards of the World Health Organization set at 50 mg / l the maximal concentration acceptable of nitrate in water consumption (OMS, 2004).

2. Physical framework of the study area

2.1 Geographical Situation:

Located in the center of Biskra (South-east Algeria), and about 50 km at the West of the Wilaya, the study area is entirely spread over El Ghrous commune whose cadastral survey represents 47% of the total surface area that is 11,628 ha (figure.1).

2.2 Geology and hydrogeology of the region:

From the geological insight ,the region of Biskra is characterized by sedimentary rocks ranging from Barremian at the base to the Quaternary at the top (Figure.2) with arenaceous and argillaceous alluvial deposit while the tertiary consists of sandstone and sandy clay as well as the limestone formations that with fractures and folds of directions N-S and NE-SO (in Dekhinet, 2005).

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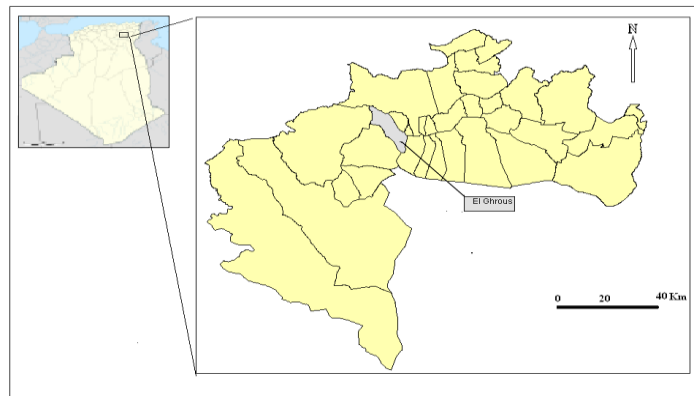


Figure.1 :Geographical situation of study area

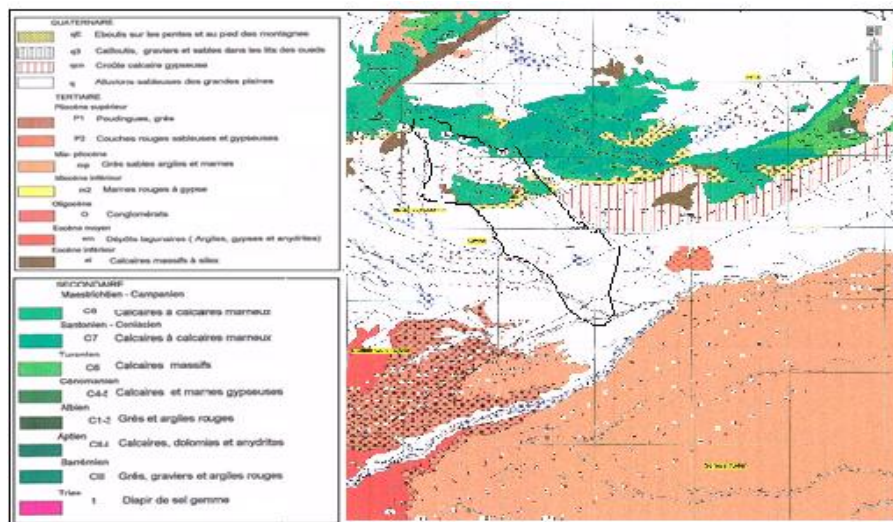


Figure 2.:Geological Map of Biskra 1/20 0000

In the light of geophysical synthesis made by SEDRATI.N et al in 2008 and hydrogeological studies on the region, it was revealed the existence of three-level of aquifers :

Phreatic Groundwater : It is situated in the accumulation of alluvial river and it is primarily fed by rainfall and infiltration of irrigation water.

Moi-Pliocene Aquifer (sand aquifer) : This layer consists essentially of an alternation of gravel and clay sand. It is poorly exploited in the Northern region (Hamel.A, 1990) but towards the south where the thickness becomes significant (300m) it becomes more sought (ANRH, 2008).

The sheet of the Lower Eocene (limestone sheet) : It outcrops in the north and becoming deeper towards the south. It consists of limestone and marly limestone.

3. Materials and methods:

For the realization of this study, we carried out a sample collection (November 2010), on 57 drillings collecting the three layers and which are located in the agricultural plots (Greenhouses and palm trees).

The physicochemical parameters pH and electric conductivity were measured in situ. The chemical analyses of the taken samples were carried out on the laboratory of CRSTRA center.

The use of a statistical method, analyzes in ACP principal components using the SPADv55 software enabled us to study the space-time variation of the quality of this water intended for the irrigation as well as the origin of the observed concentrations.

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Parameters	Method and fittings
pH and electric conductivity CE	multi parameters set 350/set
calcium, magnésium, bicarbonates	volumetric method
sulphates and les nitrates	Spectrophotometre DR5000
sodium and potassium	Spectrophotometre at JENWAY flame

Results and discussions :

Aiming to have an idea on the hydro-chemical behavior as well as the origin of the water pollution, we carried out an ACP (concerning water of the phreatic groundwater and Mio-Pliocene at the same time. And also of the lower Eocene sheet), this tool seems to us to provide best means to determine the possible bonds which could gather two or several variables during their evolution.

4.1 ACP of the two Phreatic ground water and Mio-Pliocene

The horizontal axis F1 expresses 49.65% of the variance, it is determined by two poles, that of mineral elements (Cl, HCO₃, Na, K, Mg, SO₄ and EC) and of nitrates thus showing a various origin of these elements and which can be geological for the first and anthropic for the last. The axis F2 expresses 20.63 % of information and indicates an opposition between water rich in calcium with those characterized by a poor pH.

The projection of the individuals (figure.4), shows the existence of three sets: the first is that of water with less strong mineralization (compared to the whole of the water points) and which corresponds to drillings of the Mio-Pliocene aquifer. The second is that of water which presents a strong mineralization and which corresponds to the wells of the groundwater aquifer where we recorded and the highest contents Cl, Na, K, Mg, SO₄, HCO₃. Thus, is probably explained by the pluviometric mode and strong evaporation in this area (CHEBLAOUI.M.S et al 2008).). The last group is that of the polluted water by the nitrates and which gathers the water points of Mio-Pliocene loosely founded inside the irrigated plots with culture under greenhouses and where the farmers practise a spreading often uncontrolled.

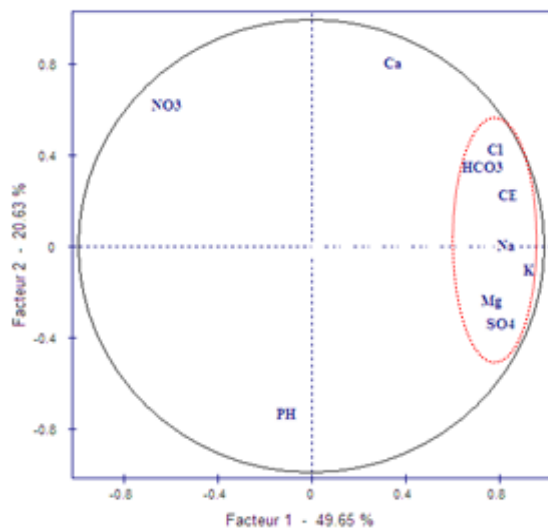


Figure 3 : projection des variables (ACP du Phréatique et du Moi-Pliocène)

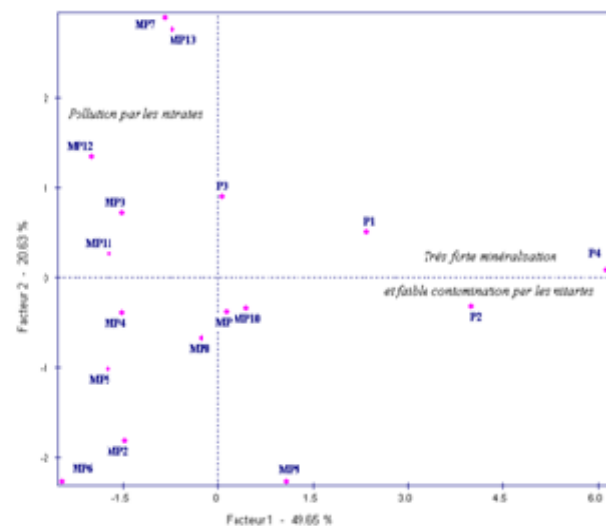


figure 4 : Projection des individus (ACP du Phréatique et du Moi-Pliocène)

4.2. ACP of the lower Eocene aquifer

For water of the lower Eocene aquifer which is a deep sheet (more than 400m), the ACP is carried out on 40 drillings located in the northern and central part of the commune. The coefficient of correlation retained for a threshold of 5% is 0.56. There are several correlations between the elements, in particular between the electric conductivity on the one hand and the sulphates, the sodium, the calcium, the potassium, the chlorides and the magnesium of the other hand which vary between 0.58 and 0.85.

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Other more significant correlations (between 0.56 and 0.84) are detected between the following elements: (Na / K and Cl), (K / Ca and Cl), (Ca / SO₄), (Mg / Cl) and (Cl / HCO₃). The nitrates have not a significant correlation with any chemical element.

The ACP circle (figure.5) is determined by the axes F1 and F2 which provide more than 62% of the total variance and thus made it possible to highlight the presence of two types of water, namely water with high mineralization and those polluted by nitrates

The projection of the individuals (figure.6), shows the existence of three sets: water always with less strong mineralization which gathers drillings which are in the central part of the commune. The water is characterized by a strong mineralization and which is located in the East part of the area where the wells are in bad state inducing to the connection between sheets and thus involving a significant rise in the electric conductivity which can exceed the 5 ms/cm. Finally, the whole of the polluted water by the nitrates and which correspond to the drillings located in palm grove or an application of organic fertilizers (manures) seems to be practised with excess (we note that the concentrations of nitrates on the level of this sheet did not exceed the standards of recommended potability by OMS).

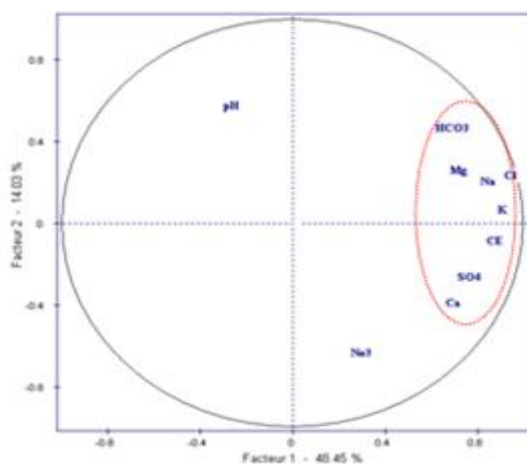


Figure 5 : projection des variables (ACP Eocène)

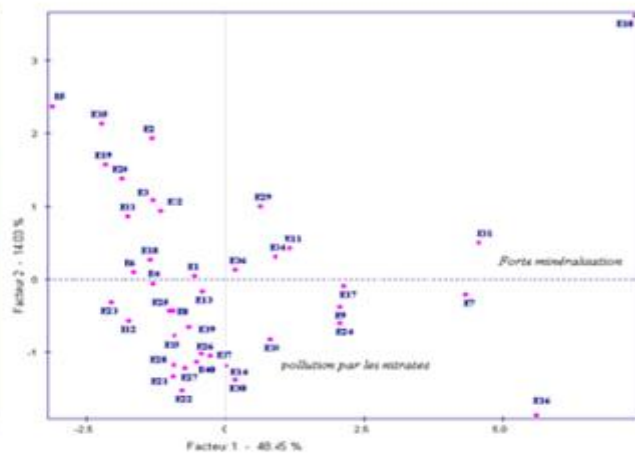


figure 6 : projection des individus (ACP Eocène)

5. Conclusion

The chemical composition of water is directly influenced by the nature of the formations tanks; thus limestones seem to be at the origin of bicarbonates, on the other hand the presence of chlorides is conditioned by the presence of clays, sands... etc. This shows the importance of the leaching of the formations crossed by water. Pollution by nitrates is of anthropic origin, due to the anarchistic use of manures.

The prevention and the fight against water pollution of agricultural origin require the setting up of actions which aim at the awareness of the farmers concerning the risks of the underground water pollution as well as the reasoned use of manures (adjusted and split in time).

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