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Research Article

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Evaluation of the Physico-Chemical Quality of the Waters of the Oulja Well in the Oum Er-Rbia Watershed

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Abstract The Spatio-temporal variations of certain physicochemical parameters were studied, in fact the sampling was carried out during the year 2014. Two samples were taken per well, and per season. The analysis results obtained show that high mineralization of the well water as indicated by the high values of the electrical conductivity and the major ions, chlorides, sodium and sulphates. A higher hardness accompanied by an evolutionary nutritive contamination. It is clear from this study that the water table in the oulja zone is contaminated and has water of degraded quality.

Keywords physicochemical parameters, Spatio-temporal variations, contamination, hardness

1. Introduction

Inherent in socio-economic development, which can not be achieved without adverse effects on the environment and the economy of many countries [1]. Thus the assessment of groundwater quality was carried out by several researchers in Morocco [2-7]. Potential sources of groundwater pollution have multiplied in recent years [8]. Among the most widespread contaminants, nitrates are important because they are produced by basic human activities (agriculture, domestic activities, industries, etc.). A high concentration of nitrate in drinking water can be pathological for humans and animals [9]. In Morocco, contamination of groundwater has attracted particular attention in recent years due to the problems caused by the increasing degradation of the water quality of aquifers, mainly by nitrates [10]. The study area is part of these coastal areas, where only water resources are of underground origin, circulating in a heterogeneous aquifer, feeding mainly through rainwater [11]. Groundwater is progressively charged with mineral salts and can reach abnormally high levels of nitrates, sodium and chlorides [12]. These high salinities are observed over the first two kilometers of the littoral fringe and in the eastern part, especially during the dry season when the aquifer is intensified for irrigation. They are due to several potential sources: marine intrusion, evaporation favored by the shallow depth of the water table, infiltration. And recycling of irrigation water loaded with salts and nitrates [13]. Thus a thorough diagnosis of the current situation of mineralized water pollution and a rigorous follow-up of its evolution are of great importance in order to be able to judge the water quality of the wells

and its impact on the environment. Ecosystem. It is in this perspective that this part of the work consists of studying the physico-chemical quality of well water at the sampled sites

2– Zone côtière oulja

Geological and Climatological Data

The sample wells are part of the rural common sidi Ali ben Hamouche placed on the coastal Chaouia it is characterized by its strategic geographical position to the north of the province of el Jadida(fig1). It is crossed by the road linking Casablanca to El Jadida; The regional road N ° 320, a provincial highway, the casa- El Jadida motorway and the railway. This situation has a great positive impact on the development of this commune and the living conditions of its population. The territory of the RC is part of the Doukkala plateau. The general orientation of the slopes is from south-east to north-west.

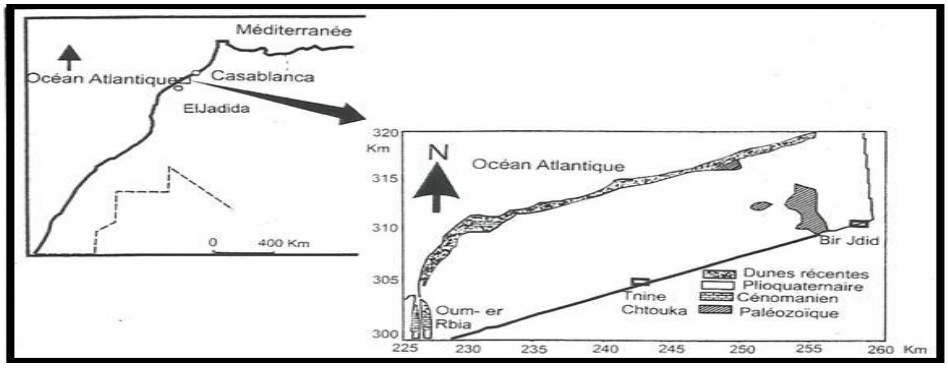

Figure 1: Geographical coverage of the coastal Chaouia (Younsi, 2001) redesigned by CorelDraw12

The surface of this plateau is characterized by its irregularity, and consists of scattered mounds crowned by more or less minute depressions. The northern and northwestern parts have a dune cord that separates it from the Atlantic Ocean. The latter is lined by the oulja of sidi Ali. Wadi Oum Er-Rabia is the natural southern boundary of the municipality. The climate of the Mediterranean type with two different seasons. The effect of proximity to the sea and the wadi serves as a regulator of the climate by means of the watering of the sea and the formation of fog. The land has no natural vegetation cover. These climatic conditions are favorable to the agricultural practice especially with the existence of oulja. Among the many climatic factors, temperature and precipitation play a key role in the flow regime.

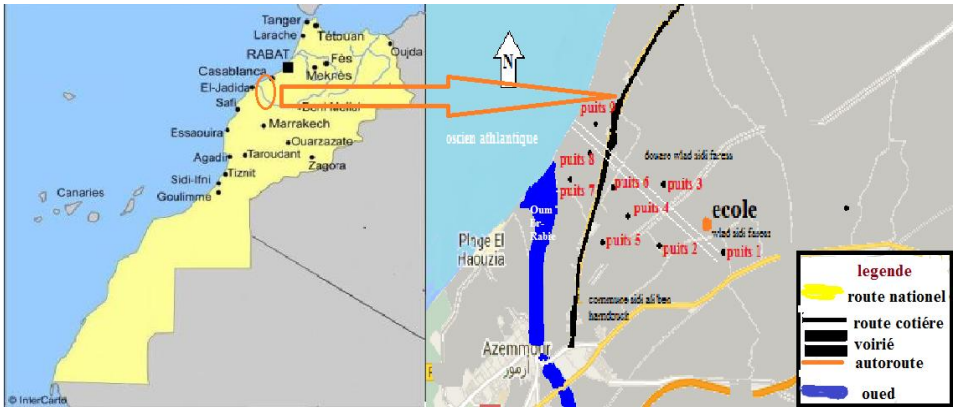

Figure 2: Location of the Well in the Oulja area

3-Physico-chemical analysis

The analyzes of the water samples were carried out in the laboratory (Labo-Mac). Temperature, pH and conductivity data were measured in situ at the time of sampling using:

* PH meter of type WTW pH 325.
* Conductivity meter of type WTWLF 96
* Mercury thermometer

On the other hand, other chemical parameters (Na, K, Mg, Ca, Cl, SO_4, H_2PO_4, NO_9, NO_2) are measured in Labo-Mac using ion chromatography.

Results

The results of the physico-chemical analyzes of the wells studied are recorded in Table 1, which includes drinking water quality standards, mean values and Of the various measured physico-chemical parameters of well water.

Table 1: Comparison of physico-chemical parameters with standards

Parameter	Unite	WHO standards	Moroccan Standards	Minimum	Maximum	Average
pH	-	6.5-8.5	8.5-9.2	7.3	7.89	7.55
Tem	°C	25-30	25-30	15	17	14.66
Con	Us/cm	180-1000	1300-2700	3.8	21.35	6.51
Ca^{2+}	Mg/l	100	160	83.46	402.66	265.47
Mg^{2+}	Mg/l	50	50	55.93	299.45	176.68
K^{+}	Mg/l	12	12	2.75	231.34	30.64
Na^{+}	Mg/l	150	200	195.47	1129.84	606.16
$SO4^{2-}$	Mg/l	250	200	155	445.7	285.94
Cl^{-}	Mg/l	200	300-750	1124.4	2562	1833.67
$NO3^{-}$	Mg/l	50	50	147.67	262.73	207.08
$NO2^{2-}$	Mg/l	3	0.1	0.016	0.26	0.164
$PO4^{2-}$	Mg/l	0.7	0.7	0.013	0.23	0.046

Temperature

Water temperature is an important factor in organic production. This is because it affects the physical and chemical properties of it; In particular its density, its viscosity, the solubility of its gases (especially that of oxygen) and the speed of chemical and biochemical reactions [14]. In the study area, the results show that the temperature does not vary greatly from one well to another (Figure 3), with a minimum of 12 ° C recorded at wells 6 and 7 during the Month January 2014 and a maximum of 20 ° C at the same well during the month of June. These fluctuations are temporal. The average values do not exceed 25 ° C, where they are in compliance with Moroccan standards concerning groundwater.

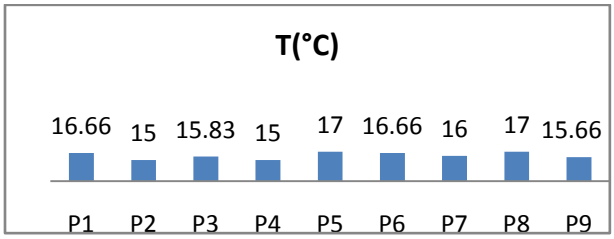

Figure 3: Spatial variation of mean water temperature in wells

pH

The pH depends on the origin of the water, the geological nature of the substrate and the drainage basin traversed [15]. This parameter conditions a large number of physico-chemical equilibria between water, dissolved carbon dioxide, carbonates and bicarbonates, which constitute buffered solutions that give aquatic life a favorable development. In most prospective wells, pH is typically between 6 and 8.5, while in lukewarm waters it is between 5

and 9 [16]. In our study region, Recorded vary between mean values 7.3 and 7.89, indicating a slight alkalinity of the well water. This alkalinity is very close to that measured by [17]. This alkalinity could be due to the calcareous and marly nature of the geological formations of the aquifer which favors the release of the carbonates and bicarbonates increasing the alkalinity of the medium. In all the wells analyzed their waters (fig.4) are favorable to irrigation, their pH is between 6.5 and 8.5. Thus these values respect the European standards for drinking water. On the other hand, the values found for pH make well water in good quality and classify it in an excellent class.

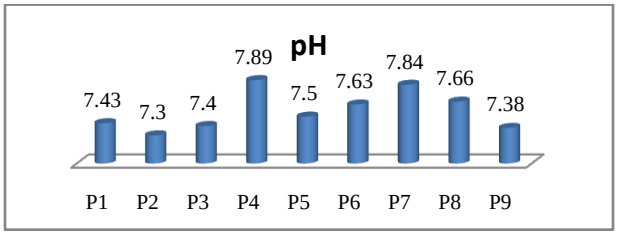

Figure 4: Spatial variation in mean pH of well water

Conductivity

The electrical conductivity of awater is the conductance of a column of water between two metal electrodes (Platinum) 1 cm2 of surface and separated from each other by 1 cm. It is the inverse of electrical resistivity. The unit of conductivity is the Siemens per meter (S / m). Conductivity gives an idea of the mineralization of a water and is therefore a good marker of the Origin of a water (8). Indeed, the measurement of the conductivity makes it possible to appreciate the quantity of the dissolved salts in the water, and therefore of its mineralization. The values recorded during the study period vary between a minimum value of 2.88ms / cm detected at well 5 during the month of November and a maximum value of 9.22 ms / cm at well 9. The electrical conductivity depends on the material charges Organic, endogenous and exogenous, generating salts after decomposition and mineralization and also with the phenomenon of evaporation which concentrates these salts in water.

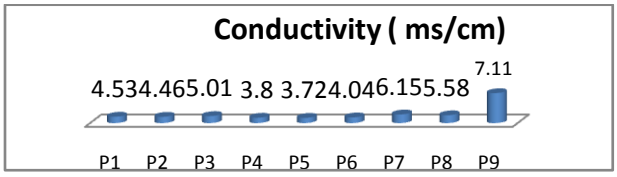

Figure 5: Spatial variation of mean conductivity of well water

It also varies according to the geological substrate traversed [14]. The analyzed groundwater has generally high conductivity values, far exceeding the guide value set by Moroccan standards 2.7ms / cm. The maximum conductivity observed during the summer at Well 9, which is 300 meters from the beach, is 7.11 ms / cm (fig.5). This increase may be due to the intensification of pumping aggravated by decreased rainfall inflows during droughts [18]. This causes marine intrusions into the web [19].

Calcium

Calcium is generally the dominant element in drinking water and its content varies essentially according to the nature of the lands traversed (limestone or gypsum) [20]. The mean calcium content of the controlled waters (fig 6) Of all wells studied are between 83.46 mg / l in well 7 and 402.66 mg / l in well 9. Indeed, the seasonal levels recorded at well 7 are quite low and less than 100mg / l, corresponding to the guideline value set by the OMS standards. However, in the other wells the hardnesses are beyond the norms. The water in these wells is therefore unsuitable for human consumption. Moreover, the values in all the wells are similar to those found in other regions of Morocco [21].

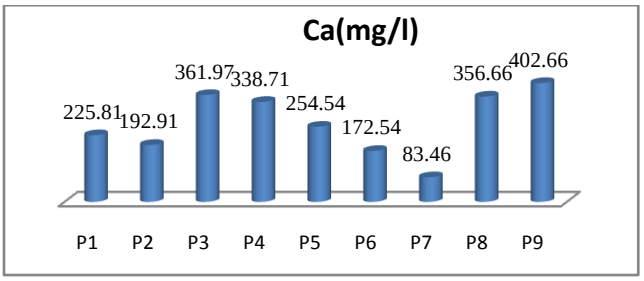

Figure 6: Spatial variation of calcium content in well water

Potassium

Potassium results from the alteration of potassic clays and the dissolution of chemical fertilizers which are used massively by agriculture. The work [22] shows that the presence of this element could be linked to the discharging of domestic waste water. In our study case and according to fig. 7, the waters of the wells analyzed have fairly low average contents and comply with the OMS standards. Except for wells 7 and 9 with higher grades. Let us note that these two wells being near the beach (well 7 is located about 30m and well 9 is located approximately 100m from the beach). This high k^+ content can be explained by marine intrusions into the water table.

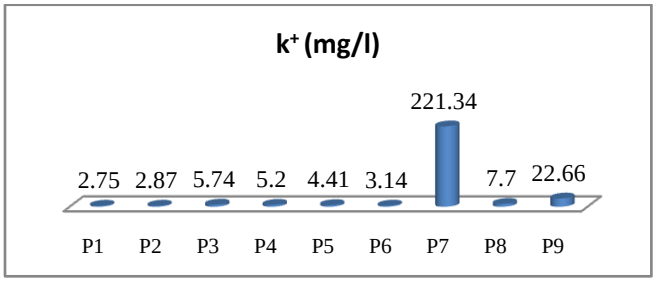

Figure 7: Spatial variation of potassium content in well water

Sodium

Sodium is a constant element of water, however concentrations can be extremely variable. Independently of the leaching of the geological formations containing sodium chloride, the salt may be derived from the decomposition of mineral salts such as sodium and aluminum silicates, marine fallout, the introduction of salt water into the aquifers, numerous industrial uses etc., a normal diet brings 3 to 5 g /l sodium (8 to 12 g / l sodium chloride.) The amount required is less than 200 mg /l for the child and 2000 mg /l for the adult [23], According to the results of the analyzes carried out during the study periods, the average sodium levels are globally concentrated and exceed the limit value 150mg / l set by WHO. Is observed at well 6, while the highest level is that recorded in well 3. Referring to the grid of Moroccan water quality standards for the production of drinking water, The wells studied belong to four groups: the first consists of a single well, the well 6 belongs to the excellent class, the second consists of wells 1 and 2 belonging to the good class, the third group Consists of wells 4,5 and 8 belonging to the middle class, which requires physical, chemical treatment for refining and disinfection. The last group contains three wells P3, P7, P9 with a high content of this element, these wells belong to the very bad class.

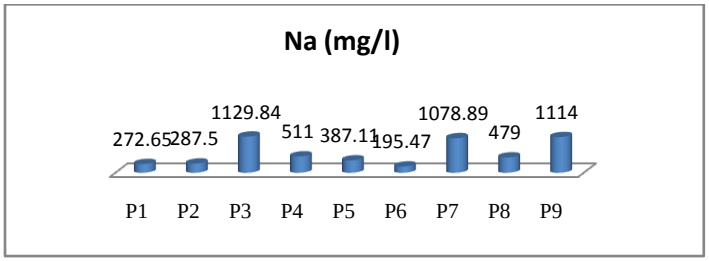

Figure 8: Spatial variation of mean sodium content in well water

Magnesium

Magnesium usually accompanies iron in rocks. Like iron, its solubility depends on Eh [24]. This parameter is found in calcareous, marl-limestone formations and in triassic formatios (gypsum). According to the results of the analyzes carried out during the study period, the average magnesium levels are globally more concentrated. All values above 50 mg / l (OMS) are recorded during sampling companions. Mean magnesium levels varied during this 55.93 mg / l study reported at well 7 at 299.45mg / l detected in well 9 (fig. 9). As regards this parameter, the majority of the waters analyzed during this study are inadmissible for consumption. By comparison, the values found in our study site are largely higher than the values measured in other studies in Morocco and are close to those in the Marrakech-Tafilalet region [21].

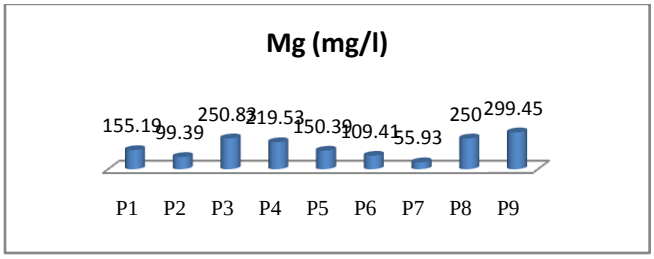

Figure 9: Spatial variation of mean magnesium content in well water

Chlorides

Examination of figure (10) shows that the contents of chloride ions vary from one well to another. The minimum value is detected in well 6 is of the order 1140.6mg / l and the maximum value recorded in well 8 of order 4571mg / l. Thus, analyzes of chlorides show concentrations in all the wells exceeding the OMS standard of 200 mg / l. According to Moroccan standards for water potability, the maximum recommended chloride concentration (CMR) is 300 mg / l, while the maximum allowable concentration (MAC) is 750 mg / l. Therefore, and concerning this parameter thus discussed, the quality of the water at the level of the study region is very fluid.

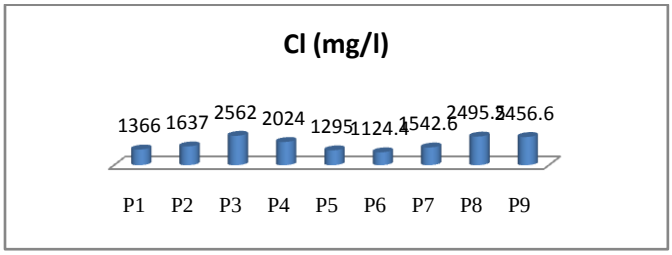

Figure 10: Spatial variation in mean chloride levels in well water

Nitrates

In our study, nitrate levels are high, ranging from a minimum mean value of 147.67mg / l observed in well 6 to a maximum concentration of 262.73mg / l reported at the well 5 fig. (11).

All wells have non-standard nitrate values. This increase in nitrate concentration would be related to sewage infiltration, excessive use of nitrogenous fertilizers, livestock and irrigation.

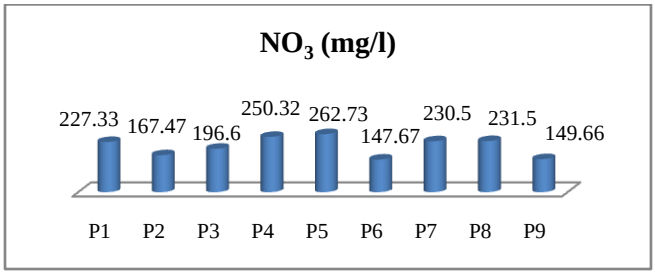

Figure 11: Spatial variation of mean nitrate content in well water

Nitrites

Average nitrite levels ranged from 0.016 to 0.26 mg / l (Fig. 12). During the study period, wells 3, 4 and 5 had pupil rates higher than the standard nitrite level of 0.1 mg / l according to OMS. The presence of Nitrites in water in significant amounts degrades water quality and could affect human health. Toxicity related to nitrite is very significant because of their oxidizing power. For the variation in temporal concentrations, the values recorded for each site during the study periods are reconciled

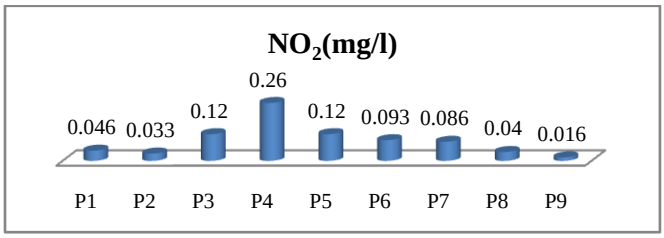

Figure 12: Spatial variation of mean nitrite content in well water

Sulphates

According to the results of the samples analyzed (fig. 13), the waters of the wells are selenite and have varying concentrations of sulphates varying from one station to another. The mean contents are between two extreme values. Minimum of 155 mg / l observed at well 6 and a maximum value of 445.7 mg / l measured in well 9.

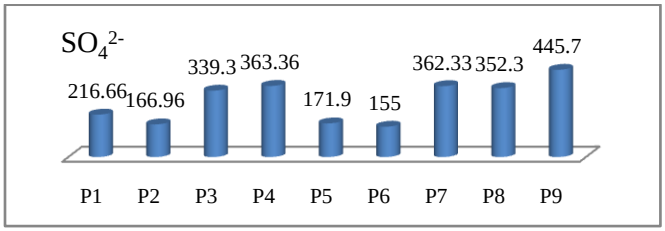

Figure 13: Spatial variation in mean sulphate content in well water

Conclusion

The results obtained in terms of the state of the water quality of the aquifer zone oulja seem to put the direct impact of the global pollution generated by marine intrusions, wastewater discharge from the local agglomeration, the effect Massive pumping and the misuse of fertilizers. Indeed, this physico-chemical quality of the waters of this aquifer reveals:

High mineralization of well water as indicated by high values of electrical conductivity and major ions, namely chlorides, sodium and sulphates.

A higher hardness accompanied by an evolutionary nutritive contamination. It is clear from this study that the water table in the oulja zone is contaminated and has water of degraded quality. Therefore a risk is exposed to the human population that uses this water for consumption, irrigation and watering.

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