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Physicochemical characteristics of the water of six sources located in Tyikomiyne region, watershed of Guir, Morocco oriental

H.Taouil[1]*, S.Ibn Ahmed[1], A.El Assyry[2], N.Hajjaji[3], A.Srhiri[3], M.Fadli[4]

[1]Laboratory of Organic Synthesis and Extraction Processes, Ibn Tofail University, Department of Chemistry, P.B. 133, 14000 Kenitra, (MOROCCO)

[2]Laboratory of Optoelectronics and Physical Chemistry of Materials, Ibn Tofail University, Department of Physics, P.B. 133, Kenitra, (MOROCCO)

[3]Laboratory of Electrochemistry and Corrosion Studies and Environment, Ibn Tofail University, Department of Chemistry, P.B. 133, 14000 Kenitra, (MOROCCO)

[4]Laboratoty of Diversity and Naturals Recourses, University B.P. 133, Kenitra, (MOROCCO)

E-mail : hamidsup@yahoo.fr

ABSTRACT

In order to effect an assessment of the physico-chemical quality of the water in the sources in Tyikomiyne, Talssint region, eastern Morocco. Many samples of water from these sources were made during two campaigns in a low water period (May and June of 2011). Spatial variations of some physico-chemical parameters were studied in six sources. The results have shown that the pH values ranged from values close to neutrality to basic values, while the electrical conductivity values were above the reference value set by the European standards and this of the World health Organization (WHO) standards.

In addition, in the water of the majority of the studied sources, the noted values of the concentration in Ca^{2+}, Mg^{2+} and SO_4^{2-} were higher than the guideline value set by the WHO standard.

Those chemical characteristics are probably due to the geological nature of the terrain traversed by the water.

KEYWORDS

Sources;
Physicochemistry;
Tyikomiyne;
Morocco.

INTRODUCTION

Overall, groundwater accounts for about 97% of freshwater inland liquid[1] and the presence of man and his chances of survival depend in many parts of the world the existence and quality of this limited and fragile resource. In fact, 75-90% of the world population uses water from groundwater.

Moreover, taking account of the available quantity and quality of inland waters, Man worries about his future on the globe. The concern is mainly due to population growth, especially in contrast to climate change and the growing water needs induced by the demographic development, industry and agriculture[2-4]. Now, the water becomes a important tool economic, social and thus political. So, its control and its good management through specialized studies are useful and even necessary.

Thus, as noted by Danielopol et al. (2004)[5], for a better understanding of these ecosystems and introduce new scientific concepts in management, planning, monitoring, protection and conservation, the study of the characteristics of groundwater in all their components is needed.

Moreover, the region Talssint (eastern Morocco) is an economic center and a popular for rural populations, some of which is nomadic. The rural exodus strengthens its demographic development. Indeed, area Tyikomiyne, a region of Talssint, the spring water is used for drinking and irrigation, but the geological nature of the soil in the region may lead to a risk of contamination by major components due to increased the electrical conductivity of waterof these sources. Many mineral elements could migrate and reach groundwater, accumulate in the food chain and pose risks to human health[6]. A complete analysis of its qualiy, and rigorous monitoring of its evolution are necessary to judge the physicochemical quality of the water and its impact on the environment Tyikomiyne area. Note, some work on the evolution of water quality in this region have already been made by Taouil and al (2011), Taouil and al (2012) also Taouil and al (2013)[7-10].

MATERIALS AND METHODS

Studied d site and sources

Tyikomiyne area is limited by the Douar [town] Ezzaouia on south, the neighborhood of Affia on the north, RP601 regional road to 'Beni-Tadjit on west and Jbal Alaajra on east. Nine sources were identified in this area (Figure 1): Annakhla (S1) Aghram (S2) Almou (S3) Albour (S4), Akboub (S5) and Moulay abdeallah (S6).

To our knowledge, these sources are natural resurgence fueled by jbel [mountain] have can not a pollution in their upstream.

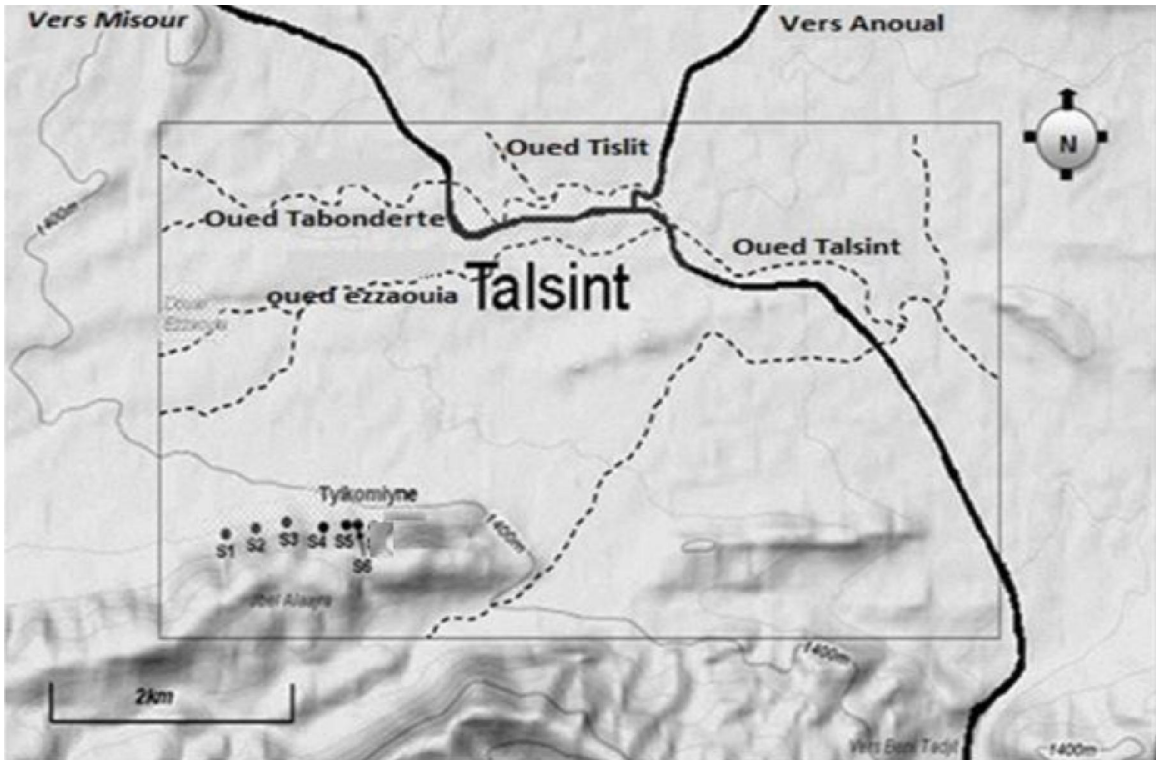

Figure 1 : Location of the studied sources S1 to S6: Annakhla, Aghram, Almou, Albour, and Moulay Akboub abdeallah sources

2 - Sampling and analysis of water

- Sampling

The samples were taken in 2011 during two campaigns in the same year in the low-water period (May 2011).

The samples were stored in polyethylene bottles thoroughly cleaned beforehand by a slightly acidified with nitric acid solution and then rinsed several times with dis-

tilled water[11]. The samples were treated in the field with ultra pure HNO3 and then transported in a cooler in less than 48 hours in the laboratory of the National Centre of Scientific and Technical Research (CNRST) Morocco.

In situ measurements

On water samples, we measured some physico-chemical parameters:

- pH : with a pH meter type field: WTW pH 325.
- Conductivity: Using a conductivity type field: WTW LF 96.
- Temperature: Using a conductivity type field: WTW LF 96.

Measurements made in the laboratory

Upon arrival at the laboratory: of every samples, we filtered a known volume of water through a filter of porosity 0.45µm, and the filtrate was used for the measurement of sulfate, orthophosphate, chloride, sodium, potassium, magnesium, calcium, fluoride and some nitrogenous materials by ion chromatography laboratory CNRST-Morocco.

RESULTS AND DISCUSSION

pH

The pH of the water summarizes the stability of the balance between different forms carbonic acid. It is influenced by the buffer system developed by carbonates and bicarbonates[12]. In groundwater, it is determined in part by the geological nature of the drainage basin. Thus in a previous work the result has showed showed that the pH is influenced by acid precipitation, biological activity and some industrial waste[10].

In the studied area, the values found in pH range from 7.17 (S2) and 8.26 (S3), (Figure 2). Thus, these values ranged close to neutrality to basic values.

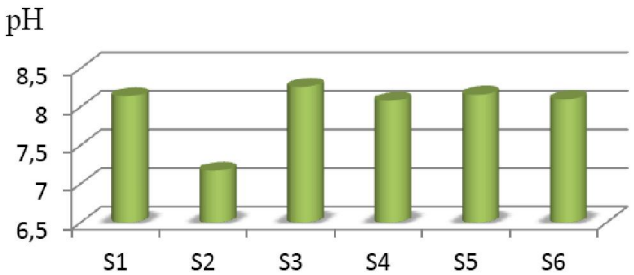

Figure 2 : Spatial variation of the average pH of the water sources in tyikomiyne area

The results show that pH values are relatively high throughout the studied part of the community. This may be due to the nature of limestone and marl of the geological catchment which promotes the release of carbonates and bicarbonates that increase alkalinity. This is not the case of wells in the south of Morocco, in the regions of Guelmim[3] and Agadir[13] where all surveyed wells have pH close to neutrality. In all study sites, these waters are favorable for irrigation (6.5 <pH <8.5) (Moroccan standards). These values are also placed in the range of potability presented by European standards (6.5 to 9). In addition, the pH values measured in the waters of stations studied place them at the excellent to good class.

Temperature

The temperature is an important abiotic factor. It is necessary since it plays a role in the solubility of gases, dissociation of dissolved salts and pH determination[14].

The analysis of figure 3 shows that the groundwater in the area studied is characterized by a relative thermal stability and the temperature of the water sources studied is relatively stable, it mainly depends on the location and climate General. In fact, the highest value (12.8 ° C) is noted at the source (1), the lowest (12.5 ° C) is recorded in S2 and S3 sources. We noticed that the temperature does not show large variations from one station to another and still remains below the annual average temperature in the region of 20 ° C. Thus, these results were observed in the case of the sources in the same area of Tyikomiyne[15].

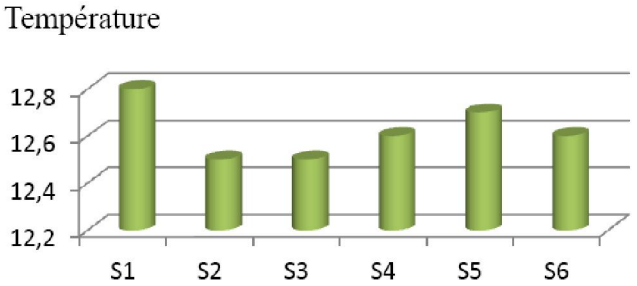

Figure 3 : Spatial variation of the average water temperature in the sources of Tyikomiyne area

Electrical conductivity

The conductivity of water is an indicator of changes in the composition of materials and their overall concentration. It provides information on the overall degree of mineralization of surface water[12], and also re-

flects the ionic charge of the water. As it is shown in figure 4, the water sources studied have conductivity values generally high and well above the reference value set by European standards (100 $\mu S.cm^{-1}$). These values are generally found between 1180 $\mu S.cm^{-1}$ as minimum value (source S3) and 1270 $\mu S.cm^{-1}$ as the maximum value (noted in S1 and S3 sources). The strong mineralization of water from these sources could be due to the existence of a local saline geological formation of the region. Thus, the values are not consistent with the standards set by the World Health Organization (180-1000 $\mu S.cm^{-1}$). This observation has been made in the case of groundwater located in the region of Marrakech and Tafilalet which have a high water mineralization and high electrical conductivity[3].

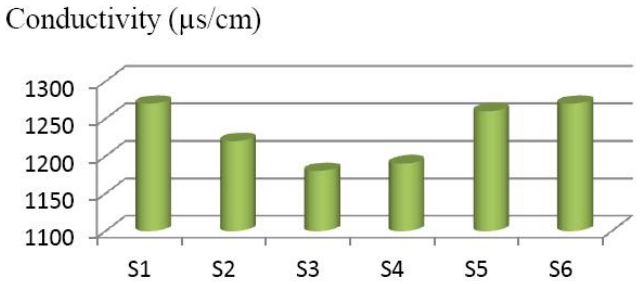

Figure 4 : Spatial variation of the average conductivity in the water of the sources in Tyikomiyne area

Sodium

According to Ayadi et al[16] and Maalej et al.[17], the sodium contributes directly to the total salinity of the water, and this salinity varies in the same direction of the mineralization[12]. So, it could be toxic to sensitive crops such as carrots, beans, strawberries and raspberries. Other work[18] reported that the Na^+ concentration exceeds 500 mg / L in groundwater in Meskiana (North-eastern Algeria) and 73% of wells exceed the drinking water standards. In our case and 'after the figure 5 shows that the content of Na^+ ion is between 13.58 mg / L in the S6 and 29.59 mg / L in the S5. Thus, these values are found well below the WHO standard (150 mg / L). Therefore waters studied Na^+ meet the standards set by the WHO.

Potassium

Potassium plays a key role in muscle contraction and heart, but also in the transmission of nerve impulses. Its concentration is quite low in most mineral waters. Previous work[18] have showed that the potassium results from the alteration of potassium clays and dissolution of chemical fertilizers are used extensively by farmers, and the presence of this element may be related to the discharge of domestic wastewater. According Gouaidia (2008)[18], the levels of the higher potassium ion are observed during the low water period, with an average of 13.44 mg / L and a maximum of 21 mg / L.

In our case (figure 6), the values found are well below the WHO standard (12 $mg.L^{-1}$). Therefore, the water studied in this element meet the standards set by the WHO.

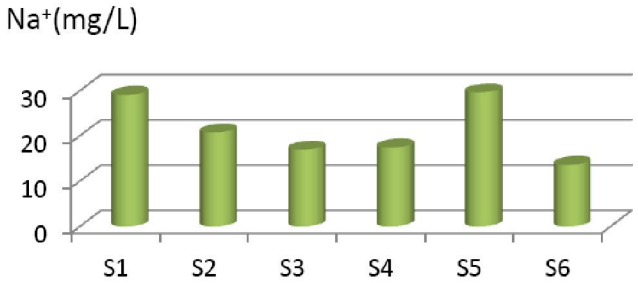

Figure 5 : Spatial variation of the average sodium ions in water sources of Tyikomiyne area

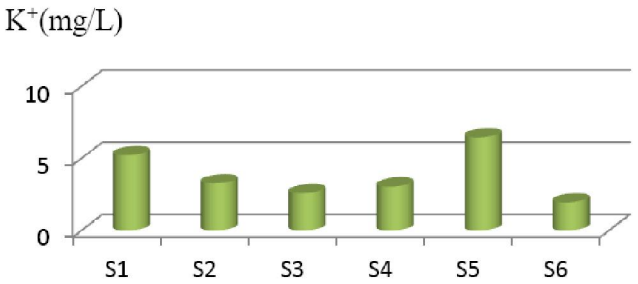

Figure 6 : Spatial variation of the average potassium ion water sources of Tyikomiyne area

Chlorides

The chlorides exist in all waters at variable concentrations whose origin can be percolated through the salt fields, infiltration of seawater into groundwater or deep, human waste (urine), extractive industries (oil, coal...) and especially the industries of salt (saline), soda and potash[19].

The results show that, in the studied water sources, the Cl^- ion content varies according the stations (Figure 7). Comparatively to Moroccan water standards for the production of drinking water, which require a maximum of 300 $mg.L^{-1}$ and 750 mg L^{-1} as mandatory value, the chloride concentrations of the water in the studied sources are consistent with Moroccan standards and that set by WHO (200 mg. L^{-1}).

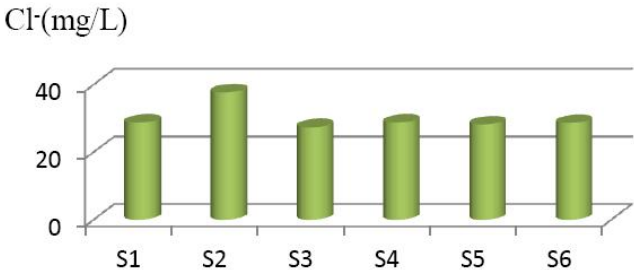

Figure 7 : Spatial variation of the average chloride ion content in water sources in Tyikomiyne area

Sulfates

The sulfates are ubiquitous in natural waters and come mainly from erosion, which is the main factor agent enrichment of surface water by dissolution of gypsum or by oxidation of the substrate surfaces or soil organic matter[20], or of the leaching of the pyriting land or the oxidation of sulfides. It can be man-made in connection with an industrial or urban pollution[3]. The work of Gouaidia (2008)[18] has shown that the highest values of sulfate ion are recorded during the period of low water in the water Meskiana (North-eastern Algeria) with an average of 472 mg/ L, following the phenomenon of evaporation and 83.5% in the wells exceeded the standard (250 mg / L) for drinking water.

In our study, concentrations of SO_4^{2-} vary from one source to another (figure 8). Indeed, the values found are between 532.2 mg/ L in the S4 and 660.4 mg/ L in the S6. Moreover, the levels found are very high in all points. According to Moroccan standards of water quality for the production of drinking water require a limit value of 200 mg L^{-1} in concentration of sulfates, and according to WHO standards this limit is 250 mg.L^{-1}. So, all sources surveyed have higher values. Therefore the noted levels of sulfate may contribute to the contamination of the studied water sources.

There are many sources of pollution by sulfates; Among All we include the industry of food, the agriculture, the oil industry and the textile. But there is not any activity of this type in the lstudied locality Tyikomiyne Has No industrial activity, Malthus. So, the pollution of water sourses in Tyikomiyne by sulfates is related to the dissolution of gypsum and of leaching of pyrifères land area.

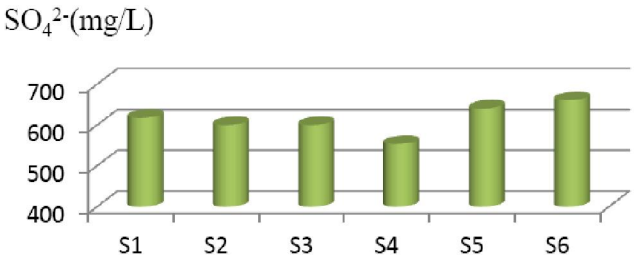

Figure 8 : Spatial variation of the average sulfate ion content of the water in the sources in Tyikomiyne area

Calcium

Principally, the calcium is the most common element in nature (evaporites, carbonates, etc.) in the form of bicarbonates or sulphates or chlorides. It comes of the geological nature of the environment in particular the broad masses of biogenic rocks[20] Thus, the calcium ion concentration is directly related to the geological nature of the land crossed by the waters. The concentration of calcium ions are high in water containing carbon dioxide from limestone or water in contact with rocks that have undergone dissolution of sulfates such as gypsum[3].

The concentration noted in the satudied sourses do not any problem for the drinking water. By cons, very soft water can cause corrosion problems ducts[21].

In addition, in all studied sources (figure 9), the concentrations of calcium ion are highly variable according the sources. Indeed, the highest content Ca^{2+} (545.01 mg L^{-1}) were recorded in S5, while the lowest level (244.69 mg L^{-1}) was recorded in the S6.

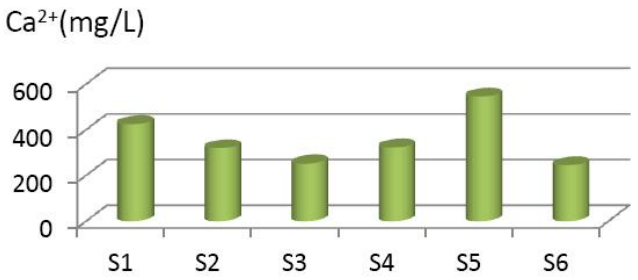

Figure 9 : Spatial variation of the average ion calcium content in the water sources in Tyikomiyne area

Thus, the values measured in the different sources studied are higher compared to the values reported in other regions of Morocco by Ait Boughrous (2007)[3] and in the majority of plants, the values found are higher than the guideline value set accepted by the WHO standard (270 mg / L).

Magnesium (Mg^{2+})

Magnesium is found in the limestones, marly limestone and Triassic geological formations (gypsum)[22]

In addition, a previous work[20] showed that magnesium is a significant element of the hardness of the water; ans, its content in water depends on the nature of the land and can be crossed in high waters through land rich in $MgSO_4$. Also, the same work[20] has signaled that the levels of concentrations of Mg^{2+} are related to the presence of Mg in sedimentary rocks.

According to the results of figure 10, the levels measured in Mg^{2+} were between 41.26 $mg.L^{-1}$ (in S6) and 95.54 $mg.L^{-1}$ (in S5). In most studied water sources, we have find that these observed values are slightly higher than the reference value indicated by the WHO '(50 $mg.L^{-1}$) These results can be explained by the dolomitic nature of the geological substrate[3]. Thus, the values measured in our sources are relatively low compared to the values of other studies reported in other sources of Morocco such as those of certain sources in Tafilalet and Marrakech (entre of Morocco)[3].

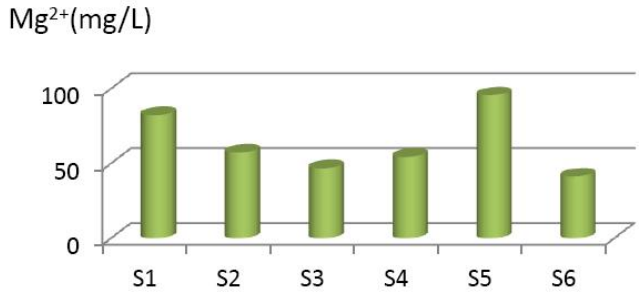

Figure 10: Spatial variation of the average water content of magnesium ions In the studied sources in Tyikomiyne area

CONCLUSION

This work forms part of the assessment of physicochemical quality of the water sources of the area Tiykomiyne, Talssint region, Moroccan eastern. Thus the results of this study showed that, the temperature of the sources does not present large variations from one station to another and still remains close the annual average temperature in the region of 20 ° C. The pH values ranged from values close to neutrality towards basic values ; this may be due to the nature of limestone and a marly geological catchment which promotes the release of carbonates and bicarbonates that increase the water alkalinity. In addition, the water sources are of on enough degradation quality in concentrations of major elements such as Ca^{2+}, Mg^{2+} and SO_4^{2-}, indeed, concentrations values of these chemical elements were higher than those of reference values set by the WHO. While, the electrical conductivity values were above the reference value both set by European standards and this of the WHO.

Thus, globally, these results can be explained by the existence of a local mineral geological formation promoting physicochemical pollution of the water in the sources in Tiykomiyne area.

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