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Research Article

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Hydrochemical Characterization of the Waters of the River Tislit-Talssint, Eastern Morocco

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Abstract The study of physical and chemical parameters is to determine hydrogeochemical characteristics of surface waters Talssint region (eastern Morocco) during the summer period 2011. Hydrographic level, Talssint area is drained by the watershed of river Guir whose outlet is directed towards the Pre Sahara Southeast Morocco. The analyzes performed on water samples taken at the river, for the determination of various chemical constituents. The projection of the physicochemical parameters of the Pliocene-Quaternary aquifer system on the Piper diagram, have allowed us to define the main features characterizing the water geochemistry and highlight their chemical dominant facies. In their paths towards, chemical elements dissolved in water have evolved into two main facies: a calcium bicarbonate and magnesium on the one hand facies and facies chlorided, sulphated, calcium and magnesium on the other hand. The results show that the water from seepage from carbonate rocks have calcium carbonate facies (Ca^{2+}, HCO_3^-). These waters are dominant compared with water calcium sulphate (SO_4^{2-}, Ca^{2+}), from seepage and dissolution near sulfated rocks (Triassic close faults).

The results of chemical analyzes are carried out two types of diagrams, Piper diagram and Schoeller-Berkaloff diagram. The study of water hydro chemical facies shows that the facies is a calcium and magnesium bicarbonate kind of general.

Keywords Hydrogeochemistry, Groundwater, Physicochemical, Middle Atlas, Morocco

Introduction

Metal contamination of aquatic ecosystems and the study of the physico-chemical quality of surface and deep water has attracted the attention of several researchers in Morocco [1-7]. In our study site and the river level, Talssint area is drained by the watershed of river Guir whose outlet is directed towards the PreSahara southeastern Morocco. The superficial flow is provided by networks riverTalssint to Ghzouane of Rmila, Anoual and by the river Elbour. The web groundwater is operated via well depth from 8 to 30 meters and the Khettars [8]. These waters are used for much in the irrigation of farmland in oases and newly installed farms in the peripheries of the past using modern fetching techniques (sensors, electric power or engine explosion). The analysis of water chemistry of surface water riverTislit-Talssint is an essential supplement to the hydrogeological study of Pliocene-Quaternary aquifer. It helps to bring information for the geological nature of the reservoir and the nature of the rocks.

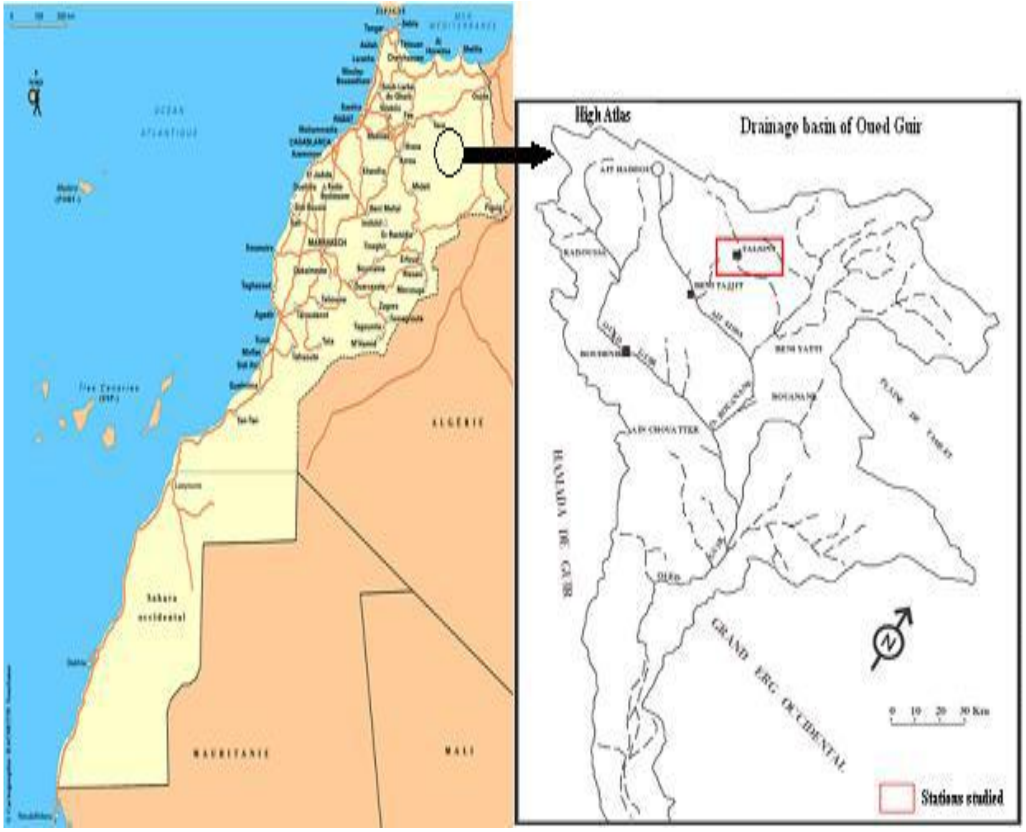

Figure 1: Study area location in the watershed of the riverGuir.

The study of these waters shows in some places a high mineralization characterized by water from seepage and dissolution of Triassic facies near faults.

Table 1: Water resources in the region of Talssint [8]

CP	Surface water			Groundwater	
	Source	**Seguia**	**River**	**Khettars**	**Well**
Talssint	23	17	03	04	20
Boumaryam	16	11	03	02	11
Bou Ichaouen	10	08	05	02	12

2. Materials and Methods

Presentation of the study area

The center of Talssint is located in the confluence of two main river, " Tisli " and " Ezawia " that form the river Talssint, it leads over to the Ravière Prefecture " Bouanane " devastating to Algeria and limited by:

- Agglomerations of the town ‘‘Boumeryam’’ south
- The neighborhood " Affia " north,
- The regional route to RP601 " Benitadjit " east,
- Neighborhoods: ‘’Ekardass’’, ‘’Egraba’’ and ‘’aitidir’’ west,

By its location, our study environment is situated on the crossroads of two regional roads, RP601 and RP604 (towards Beni and tadjitAnwal) to 190 km from the town of ErRachidia southwest and 126 km from the town of Missour west [9]. So seven stations were selected on the main axis of flow, their choice is a compromise between sampling opportunities and the need to account for the spatial organization of the River. These stations are rated as follows:

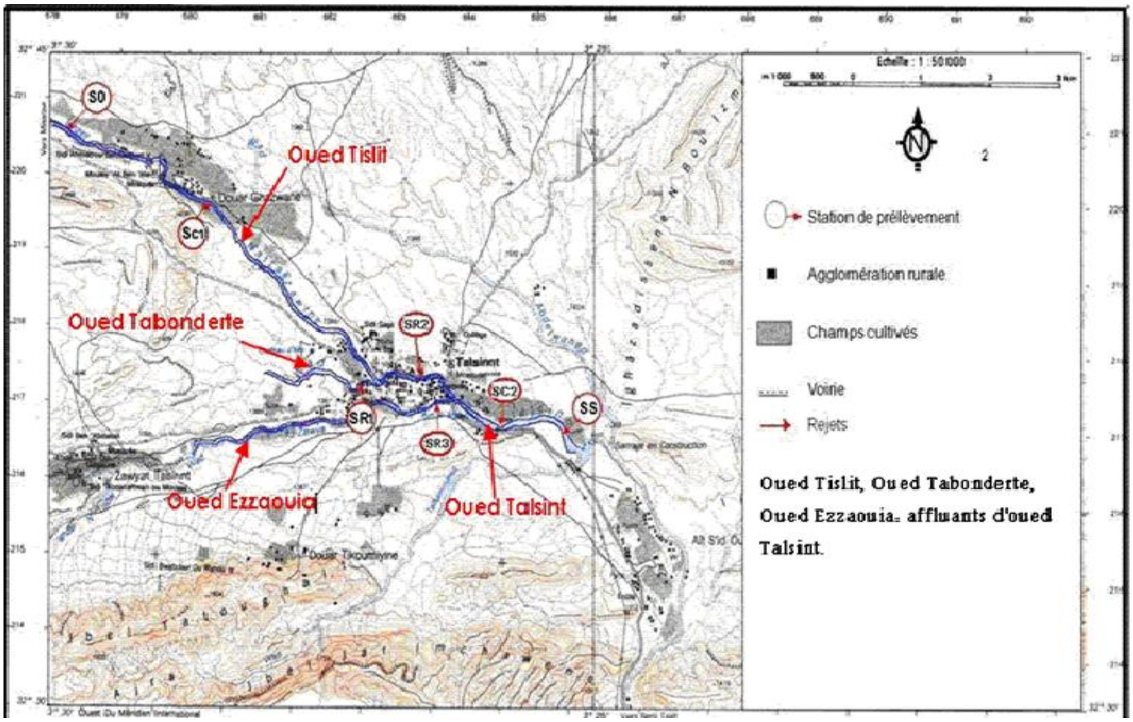

Figure 2: Location of sampling stations.

- So: witness Station is located 30 km upstream of RiverTalssint away from rural and agricultural pollution.
- SC1: Station is located on RiverTisli nearby cultivated fields I "qasarghazwane".
- SR1: resort on TabonderteRiver downstream rural domestic waste 1 (Douarissardane and rajaefiallah ...)
- SR2: Direct Sampling of rural domestic waste 2 (Douareqardass, haytoba and Talssint center ...) just nearby solid waste neighboring districts. Note that this resort is on TislitRiver downstream from its confluence with RiverTabonderte.
- SR3: Station is on Ezzaouia river upstream from its confluence with RiverTislit just was near the point of garbage 3.
-SC2: Station from Talssintriver downstream of the confluence of river Tislit with river Ezzaouia, beside cultivated fields II.
-SS: Station isTalssintjuste on river downstream of the station SC2.

The samples were sampled during a low flow period of 2011. We determined the average concentrations of heavy metals in samples taken to assess the degree of contamination by trace metals. The graphics are made through appropriate software. Indeed 250 ml of water were collected in the bed of the river, are placed in polyethylene bottles previously rinsed with nitric acid. These samples were filtered on site on 0.45µm filter and then stored (HNO_3 to 4% and at 4 °C) until mineralization. The metal concentrations were analyzed using ICP-MS laboratory CNRST-Morocco.

3. Results and Discussion

-The graphics water

The many physicochemical data useful for the characterization of water, induce the use of graphic representation as Schoeller-Berkaloff diagram and the Piper diagram. Thus, the Schoeller-Berkaloff diagram is a semilogarithmic graphic representation, on the abscissa axis are represented the different ions. For each of the major ions, the actual content in mg/L is plotted on the ordinate axis, the points obtained are connected by straight line segments [10]. In addition, Schoeller-Berkaloff diagram has advantages, in addition to its readability, the diagram enables the representation of several analyzes on the same graph, and comparing samples of identical facies but different in degree of dilution . On the other hand, the Piper diagram used to represent on the same graph numerous analyzes allowing family groupings with similar facies. It allows for the comparison of chemical compositions of natural waters. It also illustrates the chemical evolution of water in an aquifer or in mixtures of water mineralization. This point is very important in the context of monitoring the quality of water in time, or as part of regional studies of various water points comparison. It also allows to judge the relative importance of precipitation or dissolution of major elements between two or more analyzes. Thus the results obtained from chemical analyzes are presented in two types of diagrams: the triangular diagram of Piper and the vertical logarithmic scale diagram of Schoeller-Berkaloff. With these charts, we can determine the types of geochemical facies waters of the River-TislitTalssint. the triangular diagram of Piper and the vertical logarithmic scale diagram of Schoeller-Berkaloff. With these charts, we can determine the types of geochemical facies waters of the River-TislitTalssint. The triangular diagram of Piper and the vertical logarithmic scale diagram of Schoeller-Berkaloff. With these charts, we can determine the types of geochemical facies waters of the River-TislitTalssint.

Piper Diagram

The representation of the major ion contents on the Piper diagram can distinguish water two groups (Figure 3): The facies bicarbonate, calcium and magnesium represents 66.66% of the analyzed water (S0, SR3, SS, SR1, SC2) is the most dominant facies in the study area, it is generally moderately mineralized waters.

This shows that some of the water is magnesian calcium carbonate in nature. We can say that the waters of this facies are from infiltrations from calcium carbonate rocks. Facies chlorinated, sulfated, calcium and magnesium; represents 33.33% of the analyzed water (SR1, SC1, SC2, SR3, SS). This is the least dominant facies. It generally represents the most mineralized waters. The electrical conductivities in microseconds / cm are moderately high. This facies is located near areas of passages faults, marked by intense grinding and injections Triassic red clays. The presence of this facies may be due to infiltration and dissolution of evaporite rocks clayey Triassic meadows faults.

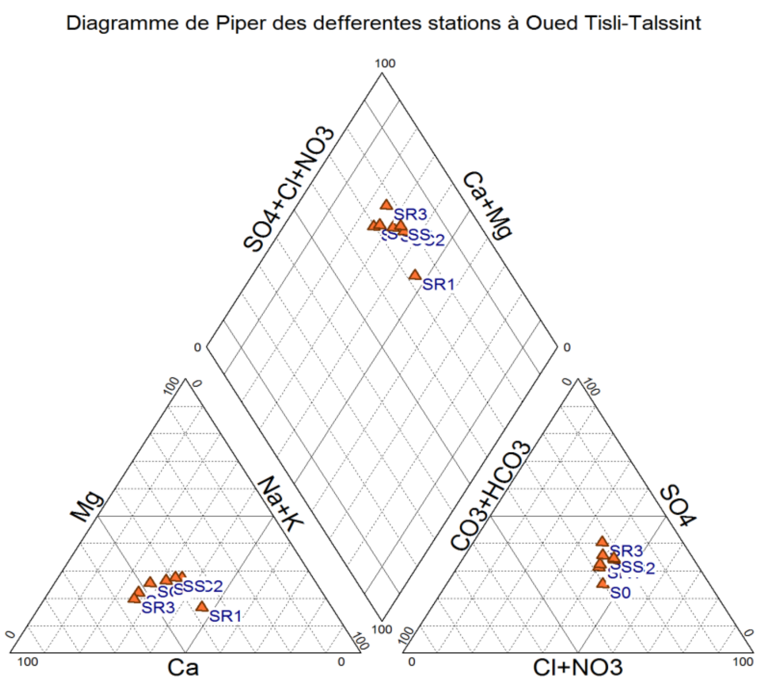

Figure 3: Diagram of Piper triangular River waters Tislit-Talssint (May 2011)

Schoeller-Berkaloff Diagram

The Schoeller diagram - Berkaloff (Figure 4) using the concentrations of major ions, provides the chemical water quality. On the Schoeller diagram - Berkaloff, we can highlight two types of gaits. The first type represents the SR1 and SR3 item with high concentration of $Na^{+,}$ K^{+} and Ca^{2+} the second group representing points S0, SR2, SC1, SC2 and with low concentration of Na^{+}, K^{+}, Cl^{-}, SO_4^{2-}, Ca^{2+} and Mg^{2+} and bicarbonate. These low levels of variations are due to changes in climatic conditions in the region. From these results it can be deduced that the waters in the Pliocene-Quaternary aquifer of the study area, are divided into two types: the first type is water close to the pole and sodium potash, characterizing waters mineralization high at SR1 and SR3. The second type is a non-aqueous bicarbonate solution and not calco-magnesian characterizing waters with low mineralization. Indeed the values found in Mg^{2+}, Ca^{2+} H.TAOUI et al [9]. In the same study site are of low mineralization and this is consistent with WHO standards and exhibit no disruption to our medium studied. Thus the average concentrations of sulfate ion recorded during the study cycle for surface waters are low and no significant difference [9]. These low values reflect low intakes of sulphate arriving at the river and the lack of evaporites in the region.

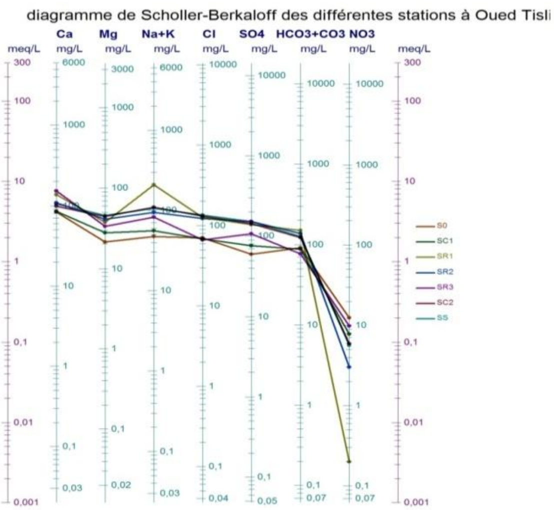

Figure 4: Schoeller diagram - Berkaloff

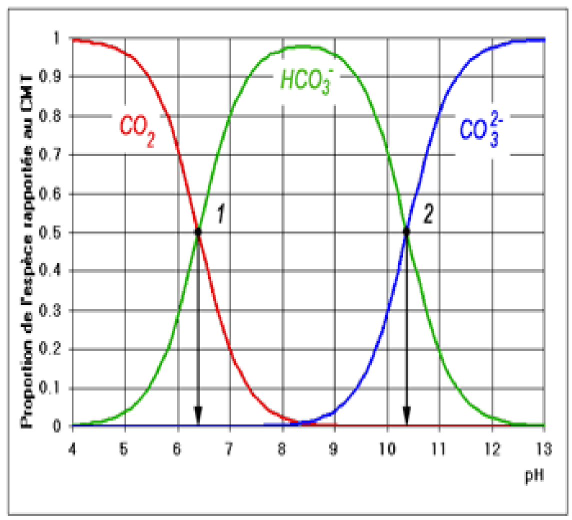

Figure 5: CO_2 equilibrium curve, HCO_3^-, CO_3^{2-} a function of pH [11].

Moreover, previous work [9], In the vas of our website, showed that the carbonates and bicarbonates evolve according to the pH of the water [11]. Indeed, the carbon dioxide gas is easily dissolved in water to form the aqueous CO_2 and aqueous CO_2 reacts with water (hydrolysis) to then form carbonic acid which is a weak acid can dissociate into bicarbonate , which is in turn dissociated into carbonate according to the reaction:

CO_2 (g) + $H_2O \leftrightarrow H_2CO_3 \leftrightarrow HCO_3^- + H^+ \leftrightarrow CO_3^{2-} + 2H^+$, and this are explained by the equilibrium curve of CO_2, HCO_3^-, CO_3^{2-} a function of pH (Figure 5) [11].

As for the chloride ions: chlorides exist in almost all of the water at widely varying concentrations and the presence of chlorides in high concentrations in water containing sodium give a salty taste. Moreover, chlorides are essential to diets. Moreover Effluent canned meat industries and some vegetables are known by a high content of salts and especially chloride. Previous work has found that salinity wastewater is a major handicap for water reused in agriculture. In our case, the values of this parameter in the studied waters found conform to WHO standards.

Conclusion

The results of the chemical analyzes are reported on two types of diagrams, Piper diagram and Schoeller-Berkaloff diagram. With these charts we determined the types of geochemical facies waters of the river and their evolution during the study cycle. The study of hydro-chemical facies of the studied waters show that the facies is generally of calcium and magnesium bicarbonate in nature, despite the small changes that present in the same facies reflecting the geological nature of the region level of all study sites.

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