Chemistry of the groundwater of the Eastern Mitidja Basin, Algeria

Mébrouk Benziada

Centre de Développement des Energies Renouvelables Route de l’Observatoire BP 62 – Village Céleste16340 Bouzaréah, Alger, Algérie

Abstract: In this article, we present the results of Eastern Mitidja basin groundwater chemical analysis realized by the Algerian water laboratory at National Water Resources Agency (Algiers) in October-November 1991. We try to show a synthetic cartography of some physic-chemical parameters in this area, the spatial quality evolution of groundwater and its irrigation aptitude. The groundwater of Eastern Mitidja basin are bicarbonate-calcareous with magnesium by place sulfated. The mineralization of groundwaters is weak in the high stream and strong in downstream (proximity of the sea). The concentrations of nitrates remain below from the World Health Organization norms over the whole of basin study. Eastern Mitidja basin groundwaters are not dangerous and can be used for irrigation.

Key words: Potability of groundwater, water of agriculture, Mitidja, Algeria.

1. Introduction

Algeria belongs to the Mediterranean basin, the Sahara occupies the major part of the country. Algeria located between Morocco and Tunisia with forms the Maghreb (Fig. 1). The study of the groundwater Eastern Mitidja basin is based on the basic chemical data for October-November 1991 period, the main objective is to contribute to the comprehension of the hydrogeology of the Eastern area of Mitidja basin. The knowledge of the physicochemical characteristics of water makes it possible to assess the quality of the groundwater of this area. Knowledge of physical and chemical characteristics of water used to assess the quality of groundwater in the study area, but also complement the results obtained by the study table is considered. The main objective is to help the understanding of the hydrogeology of the region Eastern Mitidja basin chemically characterize ground water according to the nature of the reservoir and evaluate the quality of groundwater for drinking and agriculture.

2. Method and Materials

The chemical characteristics of the Eastern Mitidja basin groundwater were studied in order to supplement the hydrological and hydrogeological existing data [1-3]. The samples taken in various water points whose sites are reported on Fig. 3 were classified by types of facies, according to their chemical composition.

Corresponding author: Mébrouk Benziada, PhD, Research Master A, research fields: hydrogeology, geothermal energy and environment.

Fig. 1  Location map of Algeria in the world.
Fig. 2  Inventory of water points Eastern Mitidja Basin (October-November 1991).

Fig. 3  Groundwater chemical map of the Eastern Mitidja Basin (October-November 1991).
The comparison of the types of water identified in several points makes it possible to characterize on the origin and the sources of refeeding of the groundwater. The classification of water presented hereafter is based on 68 samples taken at the time of the series of October measurement-November 1991, measurement rainy period has succeeded several months without infiltration (April-September) and which sees the drive of all soluble rock salt towards the sheet. The groundwater (October-November 1991) of the eastern Mitidja basin were analyzed at the chemistry laboratory of Algerian of water in Algiers.

3. Results and Discussions

3.1 Chemical Water Facies

Fig. 3 shows the distribution of six types of water. The bicarbonated type-calcic is dominating, while the others are represented locally. The bicarbonated character of this water is being due to the sediments limestones of the massif of Blidean and CO₂ of the ground, their presence in a zone indicates that the refeeding is ensured by water coming from this massif [4]. Therefore the assumption of a significant underground refeeding by the sediments limestones of the massif Blidean and along the southern limit of the Eastern Mitidja basin is confirmed.

This volume of refeeding is added to the refeeding coming from precipitations on the over wash phases in Piedmont and the small basins slopes in the neigh bour hoods.

3.2 Distribution of the Types of Water and Hydrogeological Importance

The Water of the bicarbonated type-calcic are the water most met in Eastern Mitidja basin. They are present in the major part of the plain, located between the town of Baraki and Reghaïa and Piedmont of the Atlas to the Sahel (Fig. 3). The bicarbonated character of this water being due to limestones of the massif of Blida, their presence in a zone implies that the refeeding is assured essentially by water coming from the atlas.

Water of the bicarbonated type-calcic also find themselves in the area of Rouiba-Reghaïa (Fig. 3). The formation of the Astian stage in this zone is in contact or near the quaternary aquifer of Eastern Mitidja and, it was noted that this water was that of refeeding coming from this formation. Their bicarbonated character is related to the calcareous sandstone of Astian. One also finds water of the type 1 (bicarbonated-calcic) in the coastal dunes close to Cap Matifou. This water probably acquired their characteristics while crossing the dunes with elements limestones to come realimenter the sheet.

3.3 The Electrical Conductivity of Water

The map of water conductivity (Fig. 5) of Eastern Mitidja basin watch which the highest contents are localized in Baraki, the South of Reghaïa and the entry of the Hamizwadi. This can be explained by:
- the scrubbing of grounds crossed of the southern edge of the plain,
- the effect of the almost total evaporating resumption of the lastrains, facilitated by the weak refill.

3.4 Calcium, Magnesium and Sodium

The contents of groundwater Eastern Mitidja basin are too strong in Ca⁺⁺, Mg⁺⁺ and Na⁺ and are characterized by three beaches located respectively at the south of Baraki, the mouth of the Hamiz wadi and in the Eastern extreme part of the plain (Figs. 6, 7, and 8). The sodic or calcic chlorinated facies prevail. The content of dry residue is high 1.5 g/l. Chemical nature on the one hand with their permanent contact with the various argillaceous and marly formations rich in salt persons in charge for their strong mineralization and other hand with a contamination by a light sea water intrusion.

3.5 Chlorides, Sulphates

The contents chlorides are very high by place (in
Fig. 4 Geological map of the Eastern Mitidja Basin [5].
Fig. 5  Map of electrical conductivity in groundwater Eastern Mitidja Basin (1991).

Fig. 6  Map of the calcium contents of the groundwater Eastern Mitidja Basin (October-November 1991).
Chemistry of the groundwater of the Eastern Mitidja Basin, Algeria

Fig. 7  Map of the magnesium contents in groundwater of Eastern Mitidja Basin (October-November 1991).

Fig. 8  Map of the sodium contents in groundwater of Eastern Mitidja Basin (October-November 1991).
Baraki, the South of Reghaïa and near Algiers bay). The rate of mineralization prevailing is observed in Algiers bay, because in particular of evaporation and the intrusion of the coastal sheet by marine water (Fig. 9).

Around Baraki and Hamiz, the Quaternary one is close to the ground; the sheet is in relation to the affluents of the El-Harrach river and the Hamiz river. It is thus very vulnerable to potential pollution of surface and the rivers. Between the mouth of the El-Harrach river and Cape Matifou (Fig. 3) the sheet communicates with the sea. An over-exploitation could lead to the salted water intrusion in this zone.

3.6 Contents Sulphates

Three significant sulphate places are identified. They are located on the axes draining the rivers (El-Harrach, Hamiz and Reghaïa) (Fig. 10). The sulphates can have natural varied origins (dissolution of gypsum, oxidation of minerals or artificial (rejections). The lawful standard of the World Health Organization (O.M.S) out of sulphates is set at 250 mg/l.

3.7 Nitrates: (Fig. 11)

The maximum nitrate concentrations do not exceed 50 mg/l (contents acceptable in the standards by the O.M.S), as well as a reduction in nitrates for this period of taking away which is due, partly to dilution by the first rains of autumn. The significant sectors are in the zones of outcrop where the sheet is free. Generally the rains are at the origin of the transfer of NO3 of the ground towards the sheet.

3.8 Bicarbonates

The strongest contents of bicarbonates of the Groundwater Eastern Mitidjabasin are in the zone of Baraki, Rouiba and in the south of Reghaïa (the zone where the astian is in direct communication with the quaternary one), whereas the low contents are observed in the south-western part of the plain between El-Harrach river and Djemâa river (Fig. 12).
Fig. 10  Map of sulphate contents in groundwater of Eastern Mitidja Basin (October-November 1991).

Fig. 11  Map of nitrate contents in groundwater of Eastern Mitidja Basin (October-November 1991).
4. Ability to Irrigation Groundwater Eastern Mitidja Basin

4.1 Diagramme of Richards (1954)

Analysis of this diagram relating to the period October-November 1991 (Fig. 13B), makes it possible to show that water of the quaternary aquifer in general divides into majority in the class C3S3 corresponding with a water being appropriate for the irrigation of tolerant cultures to salt on the well drained grounds. For the period of June-July 1989, all the values of the SAR are lower than 10 (Fig. 13A). These groundwaters do not cause a danger to the irrigation, except for the two points F5 and P11 where water must be used with an appreciable risk of alkalization. This phenomenon is responsible for strong mineralization. The Water is generally hard to very hard with a hardness of 87°F to the well P1 located near the sea.

4.2 Diagramme of Wilcox (1948)

By taking of the couples of points (conductivity - % of sodium), the groundwaters Eastern Mitidja basin (October-November 1991), we cannot from the diagram of Wilcox (Fig. 14A), the same spatial distribution of water than that is provided by last figure resulting from the classification of the SAR according to Richards. Also we can find results similar for groundwater for the period of June-July 1989. Water is generally “good”, locally excellent and thus being appropriate for the irrigation without major problems (Fig. 14A).

Therefore, the two methods lead to about similar results, however it is preferable to use the first method recommended by the laboratory of the department of the agriculture of California in USA for two reasons:
- the SAR makes it possible to visualize the tendency of water with contribution of alkaline and alkaline-earth exchanges.
- it makes it possible to give a good approach of the aptitude of water for the irrigation and the rates of adsorption of sodium by the ground.

The agronomists use this method in order to optimize their agricultural output.
Period June-July 1989 (Low Waters).

Period October-November 1991 (High Waters).

Fig. 13  Groundwater diagrams of the Mitidja Oriental Basin [6].
- 68 values for the year 1991 (October-November - Low Waters).
- 53 values of the year 1989 (June-July-High Waters).
Chemistry of the groundwater of the Eastern Mitidja Basin, Algeria

Fig. 14  Groundwater diagrams of the Mitidja Oriental basin [7].
- 68 values of the year 1991 (October-November - Low Waters)
- 53 values of the year 1989 (June-July - High Waters).
6. Conclusions

The hydrochemical study makes it possible to classify groundwater Eastern Mitidja basin and to identify the relation between the chemical composition of this water and the lithology of the tanks. We emphasize a feeding by the south edge of the basin as well as the predominance of a bicarbonated water-calcic slightly magnesian. The quality of the groundwater Eastern Mitidja basin is acceptable, and can be used without danger also a predominance for water supply for drinking and agricultural. The zones with strong concentration are localized in Baraki, the mouth of the Hamiz river and Rouiba.

The industrialization and the urbanization as well as to the intensification of the agricultural activities led calcic bicarbonated, slightly magnesian on the one hand, the increase in water demand and on the other hand, to the massive pollution of the rivers, coastal water and subsoil waters. In fact a station of purification in Reghaïa is in installed to treat waste water for irrigation and industry use.

A control of chemical fertilizer us is necessary in the future if the quality of water is spoital. The use of manures and other agricultural chemicals could appear necessary to a later date if the quality of water worsens. A protection of the alluvial sheet is also to be considered against usual pollution of the large accidental cities and those of the high away and the refinery of hydrocarbons of Baraki.

Acknowledgments

Author would like to thank Mr. K. Abdeladim from CDER for his helpful comments.

References

[1] Chibane, B. 1993. Pollution by Nitrates of Subsoil Waters of the Plain of Mitidja. Th. Magister-I.S.T/USTHB-Algiers. mém. of Ing. I.S.T. USTHB, Algiers, 80.
[2] Hannachi, A. 1986-1987. “Hydrochimiacal Study of the Alluvial Sheet of Mititja.” Bibliographical References.
[3] Handle, J., Imerzoukene, S., and Braillon, J. M. 1985. “Pollution Salt works of the Coastal Sheet in the East of Algiers.” Review of Hydrogeology (3): 213-226.
[4] Benziada, M. 1994. “Hydrogeological and hydrological Study of the Eastern Mitidja Plain (Application of Mathematical Model ASM to the Algiers Coastal Basin, Algérie.” Thesis of Doctorate, Franche-Comté University, 235.
[5] Binnie & Partners 1983. Schéma d’aménagement des ressources en eau de la région d’Alger et du Sébou.
[6] Richards, L. A. 1954. “Diagnosis and Improvement of Saline and Alkali Soils.” Agric. Handbook 60, USDA, Washington D.C., 160.
[7] Wilcox, L. V. (1948). “The Quality of Water for Agricultural Use.” Édit.US Department of Agriculture, Technical Bulletin, vol. 962, Washington (USA), 40.