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Contribution of hydrochemistry and stable isotopes of water to the study of the functioning of the Gharb surface water table

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Abstract – The Gharb plain is located in the northern part of Morocco. This plain was formed during the Alpine orogenic phase. Its evolution is the result of the succession of several tectonic phases staggered over geological time. The Gharb groundwater table is the subject of our hydrochemical and isotopic study. The main aim is to understand how the table functions and to assess the state of contamination by anthropogenic elements.

The hydrochemical characterization of the aquifer revealed that the groundwater is actually contaminated by anthropogenic elements whose concentrations exceed the most marked drinking standards are sulfates and nitrates. This contamination is mainly attributed to the intensive agricultural practices that take place in the region; there is also waste that plays an important role in raising the concentration of these elements.

The isotopic diagnosis of groundwater was based on analyses of water isotopes, in particular oxygen-18 and deuterium, which can provide information on the origin of groundwater, recharge processes and residence times in the aquifer.

The contribution of isotopes combined with the results obtained by the hydrogeological and hydro study chemical allows us to say that the Gharb aquifer is mainly fed by infiltration
of precipitation water and groundwater has a permanent potability between the quality (good admissible and poor.

Keywords – Gharb Plain - Hydrogeology - Hydrochemistry - Isotopes - Drilling - Wells

I. INTRODUCTION

alternatives to many natural resources (biological production, agri-food, energy and mineral deposits). However, when it comes to water supply, this progress has not been able to invent anything better than natural resources such as rain, snow and underground reserves, which are limited and likely to diminish sharply in the long term, even today, when we are already seeing a sharp decline in these vital resources.

The Gharb plain is considered one of the kingdom's main plains. It is made up of highly fertile soils and benefits from a privileged geographical location, renowned for its national socio-economic development, and significant water resources. This has enabled the development of

strong economic activities in the agricultural, industrial and urban sectors. Several studies have reported an impact on the physico-chemical quality of the Gharb's groundwater, and even the resulting water resources are highly subject to excessive exploitation. All these changes are linked first and foremost to population density and its activities. The deterioration in resource quality is a threat to the region's groundwater resources, compounded by seasonal, irregular and variable rainfall from one year to the next. Facing all these difficulties means managing existing resources rationally [1].

A. GEOGRAPHIC AND GEOLOGICAL CONTEXTLL.

The Gharb basin, located in northwest Morocco, is one of the country's largest hydrogeological basins, covering an area of 4,000 km2. It is bordered by the Drader-Souier plain to the north, the Maâmora plateau to the south, the Atlantic Ocean to the west and the pre-Ririan margin and south-Ririan wrinkles to the east, with altitudes ranging from 4 to 25 meters.

The Rharb Basin is one of the most important plioquaternary basins in Morocco, representing the foreland basin of the Rif chain, affected by continuous subsidence since the Middle Vindobonian (period during which the pre-Rif groundwater was laid). It is located between two major structural complexes: in the North, the pre-Rif and the south rifaines wrinkles, and in the South, the Maamora plain and the Hercynian meseta.

The pre-Rife domain in the North consists mainly of flyschs and paleogenic marls involved in tangential and plicative alpine tectonics with southern vergence or carryings of the front of the Rifaine chain [2].

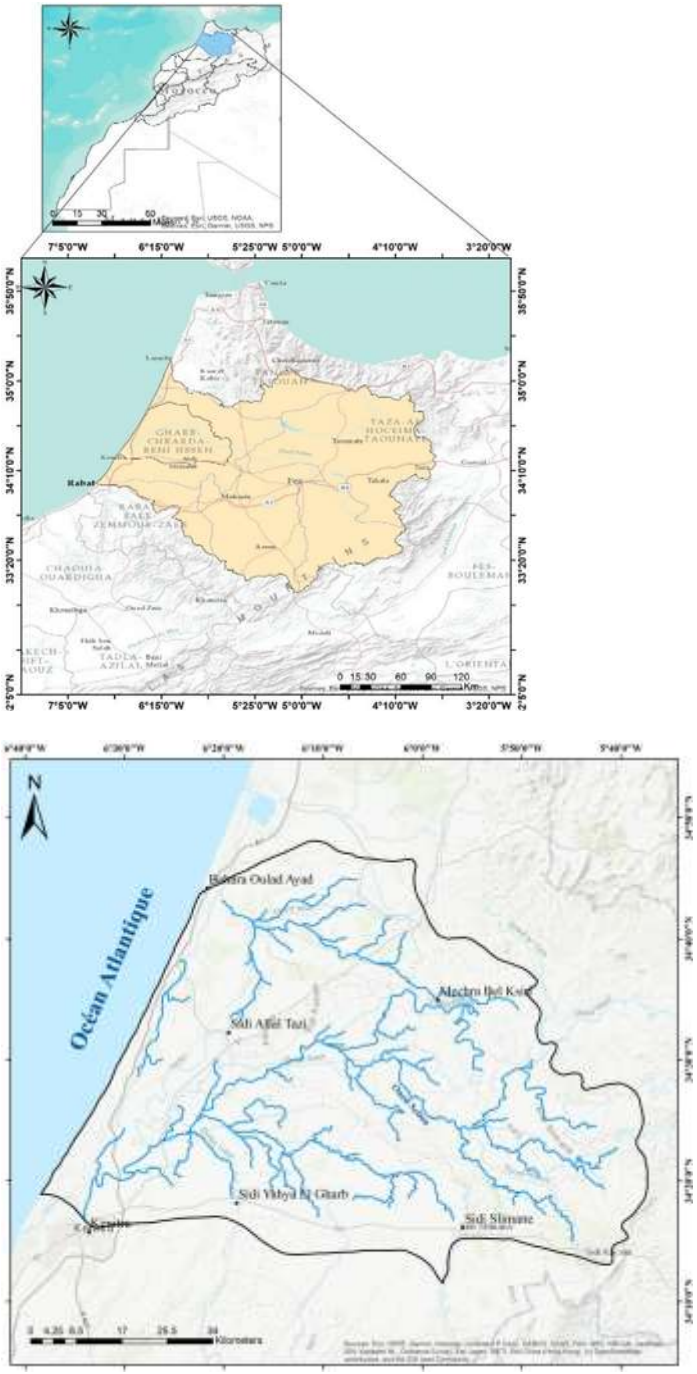

Fig.1 Location map of the study area.

B. CLIMATE FRAMEWORK

Analysis of climatic data, including precipitation, temperature, humidity and evapotranspiration, is essential for understanding the quantitative variation of groundwater and assessing its natural recharge. As far as the climate of the El Gharb basin is concerned, there are generally two main seasons: a dry season in summer and a wet season in winter [3].

II. Materials and METHOD

Our study is based on two techniques to investigate the functioning of the Gharb aquifer. The first is a hydrochemical study to determine the physico-chemical parameters (pH, temperature, conductivity, etc.) and the concentrations of chemical elements (Na+, K+, Mg2+, Ca2+, NO3, etc.). The aim of these parameters is to show the main cause of groundwater pollution, the spatial distribution and the quality of the water through the concentration rate of each element.

The second study is the isotopic study, the aim of which is to measure the oxygen18 and deterium isotopes in the water to determine the origin of groundwater recharge.

Each analysis requires specific equipment. For hydrochemical studies, we use pH meters, conductivity meters and thermometers, all designed to measure physical parameters. Ion chromatography is used to measure the concentration of chemical elements in water samples.

The percentage of 18O and deterium is measured using the Piccaro spectrometer .

II. Results

The results obtained from hydrochemical analyses show that the Gharb sassin is permanently between good and mediocre quality.

And the results of isotope analysis show that groundwater recharge is essentially due to precipitation.

III. DISCUSSION

The synthesis of chemical analyses shows that the quality of groundwater in the Gharb aquifer is remarkably degraded by high concentrations of certain chemical elements that exceed drinking water standards, giving a quality between good and acceptable for groundwater.

The isotopic study of the water table enabled us to carry out an in-depth analysis of the isotopic composition of groundwater. The aim was to understand the recharge and renewal processes of the Gharb aquifer, as well as to assess possible sources of contamination or pollution. The results revealed that the waters of the Gharb aquifer were mainly fed by local rainfall.

IV. CONCLUSION

La combinaison entre l’étude hydrochimique et isotopique de la nappe du Gharb a donné une idée sur le fonctionnement de la nappe ce qui permet de dire que la nappe est affectée par des éléments entropiques qui influence sur la qualité des eaux, les données aussi ont montrées que grâce au perméabilité des terrains la nappe est alimentée principalement par infiltration des eaux de pluies.

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