



Hydrogeological, petrophysical and hydrogeochemical characteristics of the groundwater aquifers east of Wadi El-Natrun, Egypt

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Abstract The studied water-bearing formations in the investigated area are the Quaternary and the Miocene aquifers. The groundwater movement takes a direction from the eastern and northern directions where the surface water sources are located to the western and southern directions. By comparing the water level data of 1960 and 2010, up to 25 m drawdown was noticed in the southern part due to excessive pumping. On the other hand, water level rising was observed in the same period reaching up to 10 m in the northwestern part due to seepage from the irrigation channel.

Petrophysical properties of the studied aquifers were estimated from well logs. The formation water resistivity (R_w) averages 15.2 ohm m whereas the formation factor (F) averages 5.1. The averages of the total porosity, the effective porosity and permeability are 36.5%, 33.1% and 1126.3 mdarcy, respectively. In addition, the gamma ray logs were used to estimate the volume share of shale which showed an average value reached about 34.6%. Total porosity, effective porosity and permeability showed an increasing trend to the northwestern direction where the recharge area is located.

The concentrations of TDS and the dissolved elements are higher in the shallow groundwater compared to the deeper one, which could be related to soil salinity and evaporation processes. Ion exchange, water–rock interaction and evaporation processes are the main geochemical processes affecting the chemistry of the studied groundwater. Sodium chloride/bicarbonate types

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are the most common chemical types in the study area. Most of the water samples are of old meteoric origin (Na_2SO_4 type) and old marine origin (MgCl_2 type). On the basis of SAR and EC values it is concluded that most of the groundwater samples are suitable for irrigation purposes.

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1. Introduction

During the last 50 year, several land reclamation activities have been implemented in the West Nile Delta region. These activities were based on both surface and groundwater. This development is mainly implemented by the private sector. As the reclamation processes affect groundwater quantities and flow system, interpretation of the aquifer hydrogeological, petrophysical and hydrogeochemical characteristics can help in the understanding of the hydrogeological conditions and can also aid decision related to the quality of water intended for different uses (Hiscock, 2005).

The study area lies on the West Nile Delta, between Rosetta Branch of the River Nile and Wadi El-Natron including Sadat City. It is bounded from south and north by the latitudes 30.0° N and 30.6° N , respectively (Fig. 1). The study area is characterized by semiarid to arid climatic conditions, where it is hot in summer, and cold to moderate in winter. It is characterized in general by a short rainy season with low and infrequent rainfall, high annual temperature variations, high evaporation and high relative humidity.

The West Nile Delta is characterized by a very gentle topography, lacking high relief and represents a part of the old alluvial plain. The surface of the area is mostly dissected by shallow drainage lines that directed either to the Nile Delta basin or to Wadi El-Natron and Wadi El Farigh depressions.

The surface geologic structure is relatively simple, although in the subsurface many complicated structures are known (Fig. 2). The West Nile Delta has a thick sedimentary succession that ranges in age from the Late Cretaceous to Quaternary.

2. Methodology

1. The evaluation of the aquifers petrophysical properties is attained through the analyses of logs of 18 selected drilled wells with depths varying from 60 m to 200 m. These wells are scattered through the study area (Fig. 3a). Well-logs interpretations were used to estimate the resistivity, total porosity, effective porosity, formation factor, permeability and shale volume.
2. Groundwater was sampled according to the standard sampling methods. Fifty-one water samples were collected from the study area representing the studied aquifers (Fig. 3b). Temperature, TDS, EC and pH were measured in situ. Water levels of the observation wells were measured by water level meter.
3. Hydrochemical analyses of the collected groundwater samples were done in the central laboratory for environmental quality monitoring in the National Water Research Center, Egypt. Titration methods are used for determining the concentration of carbonate, bicarbonate, calcium

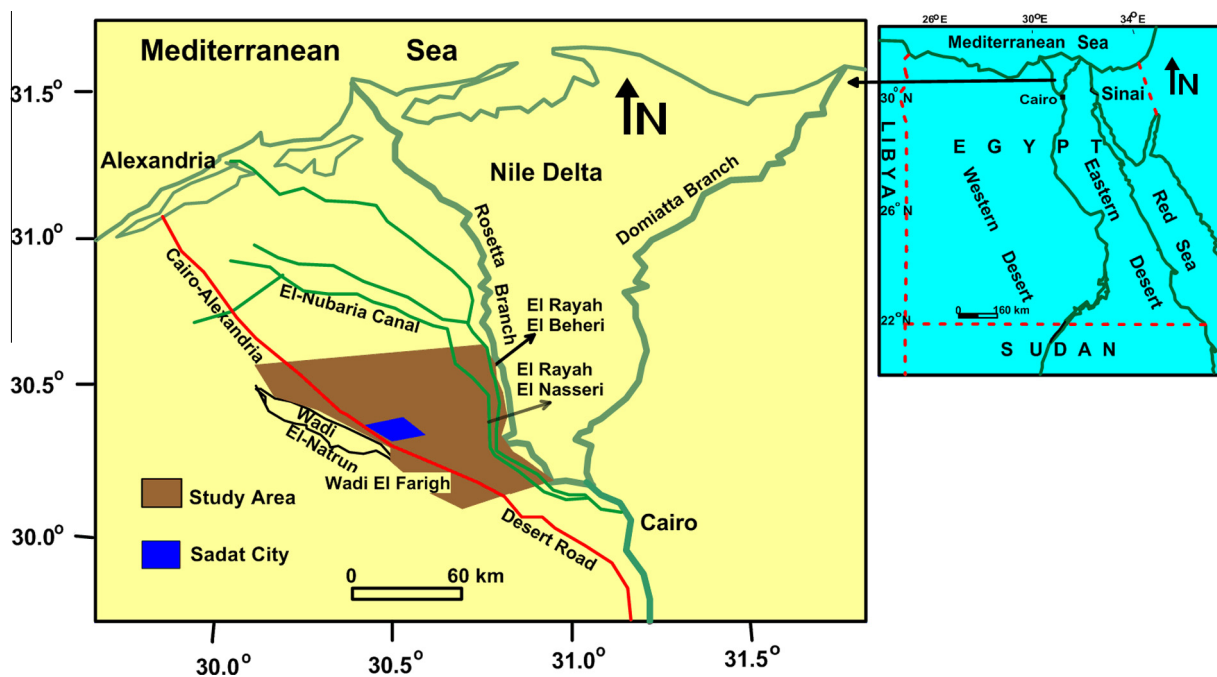


Figure 1 Location map of the study area.

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