

Implication of salinity sources, geochemical evaluation and upper aquifer characterization of Jifarah plain, NW-Libya

Nawal Al Farrah and Kristine Walraevens

Laboratory for Applied Geology and Hydrogeology, Ghent University,
Krijgslaan 281 S8, Ghent-9000, Belgium.

Nawal.AlFarrah@ugent.be, Kristine.Walraevens@ugent.be

ABSTRACT

The semi-arid to arid climate of Libya presents several challenges for maintaining sustainable water supplies for domestic, industrial, and agricultural uses. Libya has one of the lowest global renewable water resource capacities due to low rainfall rates, high evaporation, no reliable surface water resources, along with a high per capita water consumption rate. This combination of factors created an imbalance between water supply and demand, and increased the region's reliance on new water resources including desalination, water reuse, and a large water transfer project.

The rapid economic expansion, coupled with sharp population growth of the Jifarah Plain, NW-Libya has created an immediate need for proper groundwater reserves, not only to meet the increasing population demands, but also to secure a contingency plan. The unconfined coastal aquifer of Jifarah Plain is characterized by the presence of saltwater. Seawater intrusion along the coast of Jifarah Plain due to overpumping of the first aquifer of Miocene-Pliocene-Quaternary age is the main reason for the observed increase in salinity. In order to assess the influence of seawater on the aquifer, it is essential to elucidate the sources of salinity and to understand the hydraulic properties and hydrogeochemical conditions of the upper aquifer system.

Understanding the geochemical evolution of groundwater is important for sustainable development of the water resources in the plain. Water samples were collected from 140 sampling points in the study area and analyzed for the major cations and anions (Na^+ , K^+ , Ca^{2+} , Mg^{2+} , SO_4^{2-} , Cl^- , HCO_3^- , CO_3^{2-} , Fe^{2+}). The analytical process is mainly based on water type classification according to Stuyfzand (1986), graphical illustration methods (Piper diagram), ionic ratio diagrams, maps and hydrogeochemical profiles showing the spatial and vertical distribution and interfaces of water quality parameters in the study area. Aquifer hydraulic parameters were interpreted from pumping tests with several models.

Seawater intrusion along the coast of the Jifarah area due to overexploitation of the upper aquifer is clearly indicated by the results of the study. The majority of analyzed samples have CaCl_2 type, which is the typical water type appearing during salinization processes, resulting from the intrusion of NaCl water into CaHCO_3 water saturated sediments. In trying to define the hydraulic parameters using various models, the main problem is basically linked to the presence of strongly anisotropic hydrostructures, which can substantially influence the hydrodynamics of the entire groundwater system. The curve-fitting results show the following hydraulic parameters: an average transmissivity of $44.55 \text{ m}^2/\text{d}$ and hydraulic conductivity of 0.89 m/d .