Ain Shams University
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Geology Department

DEVELOPMENT OF THE WATER RESOURCES IN WADI QENA BASIN, EASTERN DESERT, EGYPT

A Thesis Submitted

BY

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For

The Ph. D. Degree in Geology
(Hydrogeology)

To
Geology Department, Faculty of Science
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Approval sheet

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This work is dedicated to

The soul of My Father,

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ABSTRACT

Wadi Qena basin represents a promising area in the Eastern Desert of Egypt for land reclamation and settlement of new communities. It is located between latitudes 26° 15´ 00" & 28° 15´ 00" North and between longitudes 32° 15´00" & 33° 30´33" East. The average annual precipitation over Wadi Qena basin ranges from 13.43 mm/y on the northeastern part of the study area to 2.78 mm/y on the western parts.

The present work focuses on the factors controlling the water resources development in Wadi Qena basin. It is conducted through detailed geomorphologic, geologic and hydrogeologic studies for the study area. Geomorphologically, Wadi Qena basin is divided into two main geomorphic units; the highlands and lowlands. The highlands include the Red Sea mountainous terrain, the high plateaus (El Maaza limestone and El Ababda sandstone), the low plateau and hilly area. The lowlands embrace the morphotectonic depressions, piedmont plain and drainage networks. The assessment of the flood strength and hazard degrees of Wadi Qena sub-basins indicates that Wadi Fattera sub-basin has the highest hazard degree while, Shahdeen, Jurdi and Um Solimate sub-basins have the lowest. Stratigraphically, the rock exposures along Wadi Qena basin belong to a range in age from Precambrian to Quaternary. Petrographically, Twenty-five thin sections from the exposed succession along Qena-Safaga road represents the Nubia sandstone (Abu Aggag Formation) are investigated for their petrographical constituents and the diagenetic processes. Four main microfacies association are recognized including; quartz arenite, sub-litharenite, quartz wacke and pebbly quartz wacke. Compaction and cementation are the main diagenetic processes. The studied sandstone thin sections have well developed intergranular porosity in most samples ranging between 10-21%. Based on Landsat images, aeromagnetic data, geologic maps and field investigations, the area of study is structurally controlled by two main shear zones; Qena-Safaga shear zone (QS) and Najd shear zone. Their trends are northeast-southwest (NE-SW) and northwest- southeast (NW-SE), respectively. Spatial analysis of these structures refers that the surface shear zones and faults are an echo of the deep seated faults dissecting the massif belt of the Precambrian crystalline rocks and the overlying Phanerozoic strata. This situation favor the strong influences of uplift related sub-vertical faults on the

groundwater flow and aquifer connectivity in Wadi Qena basin. Hydrogeologically, four water-bearing formations are recognized in the study area. They comprise the Quaternary aquifer, the Post Nubia aquifer, Nubia sandstone aquifer, and fractured basement aquifer. The Nubia sandstone and Quaternary aquifers are the most promising water-bearing formations in Wadi Qena basin. The exploitable thickness of the Nubia aquifer is 200m.The water salinity of this aquifer ranges between 1300 mg/l to 2251mg/l.

The environmental stable isotopes (Oxygen, Deuterium) reveal four isotopic groups. These comprise; group (I) highly depleted Nubia water, group (II) modern water in fractured basement, group (III) a mixed group between Nubia water and recent water and group (IV) a mixed evaporative group between Nubia and modern waters with a considerable deviation from the global meteoric water line.

For sustainable development of the water resources, based on the present investigations, several recommendations are suggested. Among them are; the construction of a strong controlling system (dames, barriers and tunnels) to mitigate the flash floods and harvest their water in order to use in the development activities and projects. Good management of The Quaternary aquifer in Wadi Qena basin by using modern techniques of irrigation to avoid the deterioration of the soil and water. The Nubia sandstone aquifer has a good water quality. More geophysical exploration and hydrological investigation are needed especially in the downstream portion of Wadi Fattera sub-basin, where it receives a considerable recharge of meteoric and fresh water from the underlying Nubia sandstone aquifer.

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CHAPTER (IV) HYDROGEOCHEMICAL CHARACTERISTICS OF GROUNDWATER