GEOENVIRONMENTAL AND STRUCTURAL STUDIES FOR DEVELOPING NEW WATER RESOURCES IN ARID AND SEMI-ARID REGIONS USING REMOTE SENSING AND GIS

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An Abstract Presented to the Graduate Faculty of
Saint Louis University in Partial Fulfillment of
the Requirements for the Degree of
Doctor of Philosophy

2011

ABSTRACT

Water crises are rising with increasing world population and decreasing of freshwater resources. This problem is magnified in the arid and semi-arid regions because surface water resources are very limited and highly unreliable and therefore groundwater is the primary source of water supply in these regions. This study presents an integrated approach for the identification of groundwater occurrences using remote sensing, geological, and geophysical data, and establishing sustainable paths to groundwater management. The Central Eastern Desert (CED) of Egypt was selected as a test site for this study because its climate is arid and there is an urgent need to identify potential areas for groundwater accumulations. Field investigations indicated that the CED has three types of aquifers; shallow alluvial (SA), and fracture zone (FZ) aquifers in the valley depressions, and deep aquifers in the sedimentary succession that range in age from Late Cretaceous to Recent in the marginal extensional sub-basins (ESB) along the Red Sea coast. I developed three models: 1) a Geographic Information System (GIS) model for groundwater potential in the SA and FZ shallow aquifers; 2) a kinematic model for the development of the ESB; and 3) a groundwater budget model for the ESB aquifers. The GIS model is based on the analysis of remote sensing data of the Phased Array L-band Synthetic Aperture Radar, the Landsat Enhanced Thematic Mapper Plus, and the Advanced Spaceborne Thermal Emission and Reflection Radiometer digital elevation model. The model was evaluated and proven successful against the existing shallow water wells, and by geophysical surveys using Ground Penetrating Radar and Geoelectric methods. The kinematic model indicated that the ESB were formed in the orthogonal rifting phase in the late Oligocene that is followed by oblique rifting phase during the

early Miocene which resulted to the en-echelon pattern of the inland ESB and nucleation of the rift depression into segments separated by oblique-slip accommodation zones. The groundwater budget model shows that the ESB aquifers have considerable amounts of paleowater that can be purified and used for drinking. The renewable groundwater of SA and FZ aquifers can be used for herding, irrigation, and ore dressing in the mining zones.