

Detecting Potential Geothermal Sites by Using Well Logging, Geophysical and Remote Sensing Data at Siwa Oasis, Western Desert, Egypt

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Abstract : Egypt made significant efforts during the past few years to discover significant renewable energy sources. Regions in Egypt that have been identified for geothermal potential investigation include the Gulf of Suez and the Western Desert. One of the most promising sites for the development of Egypt's Northern Western Desert is Siwa Oasis. The geological setting of the oasis, a tectonically generated depression situated in the northernmost region of the Western desert, supports the potential for substantial geothermal resources. Field data obtained from 27 deep oil wells along the Western Desert included bottom-hole temperature (BHT) depth to basement measurements, and geological maps; data were utilized in this study. The major lithological units, elevation, surface gradient, lineaments density, and remote sensing multispectral and topographic were mapped together to generate the related physiographic variables. Eleven thematic layers were integrated in a geographic information system (GIS) to create geothermal maps to aid in the detection of significant potential geothermal spots along the Siwa Oasis and its vicinity. The contribution of total magnetic intensity data with reduction to the pole (RTP) to the first investigation of the geothermal potential in Siwa Oasis is applied in this work. The integration of geospatial data with magnetic field measurements showed a clear correlation between areas of high heat flow and magnetic anomalies. Such anomalies can be interpreted as related to the existence of high geothermal energy and dense rock, which also have high magnetic susceptibility. The outcomes indicated that the study area has a geothermal gradient ranging from 18 to 42 °C/km, a heat flow ranging from 24.7 to 111.3 m.W. k⁻¹, a thermal conductivity of 1.3-2.65 W.m⁻¹.k⁻¹ and a measured amplitude temperature maximum of 100.7 °C. The southeastern part of the Siwa Oasis, and some sporadic locations on the eastern section of the oasis were found to have significant geothermal potential; consequently, this location is suitable for future geothermal investigation. The adopted method might be applied to identify significant prospective geothermal energy locations in other regions of Egypt and East Africa.

Keywords : magnetic data, SRTM, depth to basement, remote sensing, GIS, geothermal gradient, heat flow, thermal conductivity

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