Structural and Geospatial Analysis for Discovering New Geothermal Fields along the Gulf of Suez Rift and Egypt

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9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

Egypt is bounded to the east by what has been interpreted as a median spreading center in the Red Sea and Gulf of Suez and this may reflect the importance of these areas for geothermal development. Lately, many studies and approaches, such as geochemical and geophysical techniques, have been applied intensively in the vicinity of the Gulf of Suez for geothermal exploration in Egypt. Corrected bottom hole temperature data (BHT) of deep onshore and offshore oil wells spreading along the eastern and western coasts of the Gulf of Suez, were investigated in this study. A conceptual hydrothermal model is developed for the hydrothermal flow system in Hammam Musa (43°C), Hammam Faraun (74°C), and Ayn Musa (37°C) hot springs. This study focuses on understanding the mechanism of the geothermal system along the Gulf for future use, locating sites with higher temperatures, and revealing the hydrogeochemical characteristics of the geothermal water and their relation with existing geological structures. Heating by conduction via the geothermal gradient resulting from uplifting of hot rocks at deeper depths drives geothermal waters upwards along faults and fractures that act as hydrothermal pathways. Establishing a hydrogeologic conceptual model can further help to determine flow paths, including recharge through flow discharge processes, as well as the mixing behavior between meteoric and sea water through the different structures. Here, the GIS, remote sensing and field measurements were integrated to assess the geothermal changes in the study area. Landsat-8 and Shuttle Radar Topography Mission (SRTM), were utilized to map relevant physiographic variables including elevation,

surface gradient, lineaments density, land surface temperature, and major lithological units. The present research has identified multiple sites of high geothermal potential spreading along much of the southwestern and southeastern sides of the Gulf Rift. The present approach could be adopted, with some modification, to locate potential sites for geothermal energy in other places in Egypt and East Africa.