Gravity and Magnetic Investigations of the Greater Magadi Area in Kenya

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2009

ABSTRACT

Magadi area is located in the southern part of the Kenyan rift, an active continental rift that is part of the East African Rift system. Thermal manifestations in the form of hot springs in the northern and southern shores of Lake Magadi and high heat flows suggest geothermal potential in the area. Local seismic activity monitored previously around Lake Magadi revealed an earthquake cluster caused by swarm activity in the rift centre at shallow depths, which was probably triggered by magma movements. Magma detected at shallow depths may be used as a heat source for a geothermal resource while seismic activity due to its presence may be considered a geo-hazard to nearby cities.

Ground magnetic and gravity investigations were carried out as a follow-up to locate any body at depth with sufficient magnetic susceptibility and density contrast respectively that may represent magmatic intrusions. The necessary corrections were applied to both raw gravity and magnetic data and Bouguer and magnetic contour maps prepared respectively. Euler deconvolution technique was used to image depth to the causative bodies. From the magnetic field data, an attempt was made to estimate depth to the curie isotherm using spectral analysis. The isotherm is a marker to the depth below which the rocks cease to be magnetic when their temperature exceeds Curie point temperature. The Curie point depths obtained range from 5.2-8.3 km along the selected profiles suggesting a high geothermal gradient. The estimated vertical temperature gradients along the profiles range between 69.92 ˚C/Km and 111.53 ˚C/Km. 2-D gravity and magnetic models of the subsurface structure were also generated by forward modelling. A body of density of 3.20 gcm^{-3} and susceptibility contrasts 0.0428 SI was modelled on the northern region near little Magadi at a depth of approximately 0.4 km. The location of the body coincides

with the area where earthquake swarm occurs. Such a body of high density and susceptibility contrasts may consist of hot mantle derived material that may have intruded the crust. The slowly cooling magmatic intrusions heats underground water producing hot springs that issue from faults. Earthquakes recorded may be due to stress concentration due to crustal heterogeneity due to magmatic intrusives. The result of this study hence indicates presence of shallow heat sources that could harness geothermal energy exploration. The intrusives detected may be causing stress on the rocks and hence chances of an earthquake are high.

As a measure to avert destruction in event of such earthquakes, earthquake resistant structures are recommended in major towns in the vicinity of Magadi area. A detailed reconnaissance gravity and magnetic survey is recommended in the north eastern and southern area of Lake Magadi to image the bodies at a higher resolution. This could not have been achieved due to large station spacing resulting from large area coverage and inaccessibility of some regions that were security restricted zones. Other studies to determine temperature and other parameters of importance in assessing a geothermal resource are recommended in this area.