ASSESSMENT OF TERRESTRIAL RADIOACTIVITY DISTRIBUTION IN OLKARIA GEOTHERMAL FIELD AND ITS ENVIRONMENTAL IMPLICATIONS

SOLOMON WANGILA NAMASWA
G296-003-021/2014

A Thesis Submitted to the Geothermal Energy Trainning and Research Institute of Dedan Kimathi University of Technology in Partial Fulfilment for the Award of the Degree of Master of Science in Geothemal Energy Technology

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DECLARATION

Student's Declaration

This thesis is my original work and has not been presented in any university/institution for a degree or for consideration of any certification.

Signature ..... **Date** 06/06/2017

SOLOMON WANGILA NAMASWA

Supervisors' Declaration:

We confirm that the work reported in this thesis was carried out by the candidate under our supervision as University supervisors

Signature: ..... **Date:** 7/6/2017

Prof. N.O MARIITA

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ABSTRACT

The adoption of geothermal energy in Kenya for electricity generation has grown and become an adorable part of the substitute energy blend and from the current rate of geothermal installation it may soon overtake hydro as the leading source of energy. Despite the fact that geothermal energy has been described as clean energy, uncertainty associated with the exploitation of deep subsurface fluids need intensive assessment and dissemination within the community and with the public. Radioactive decay assists in production of a high temperature gradient in the subsurface for geothermal energy production since the slow decay of radioactive elements produces approximately half of the heat that drives earth processes such as continental drift, ocean spreading and plate tectonics. This may lead to an elevated concentration of radioactive elements in a geothermal setting. In this research activity concentrations of radioactive elements of natural origin in Olkaria geothermal field was measured in relation to other physico-chemical parameters such as temperature, TOC, pH and specific gravity, estimated the absorbed dose rate, annual effective dose rates and the hazards index. Activity concentrations was determined by use of NaI(Tl) gamma-ray spectrometer, the soil pH using pH meter, the Total Organic Carbon using wet chemistry technique, in situ temperature obtained by use of a thermometer and specific gravity was determined by use of Water Pycnometer. The study reported that the activity concentrations in rock samples for ^{238}U, ^{232}Th and ^{40}K were 66.42±16.02Bq/kg, 46.92±9.52Bq/kg and 512.84±226.49Bq/kg while in sediment, the levels were 64.62±15.17Bq/kg, 48.69±9.28Bq/kg and 525.86±211.54Bq/kg respectively in Olkaria geothermal field. In the control samples (from Ongata Rongai, over 100km away), the activity levels of radionuclides were 364.3±2.97Bq/kg, 52±1Bq/kg and 34.64±0.99Bq/kg for, ^{40}K, ^{238}U and ^{232}Th in rock samples and 350.36±3.82Bq/kg, 37.08±1.34Bq/kg and 35.11±0.52Bq/kg in sediments respectively. The mean absorbed dose rates in rocks from both Olkaria geothermal and Ongata Rongai samples were 80.56±17.77nGy/h and 70.82±1.72nGy/h respectively. In sediments, the average absorbed dose rates in both the samples were 81.35±16.88nGyh^{-1} and 54.26±2.05nGyh^{-1} respectively. The mean AEDR for rocks samples in the two areas were 0.1mSv/y and 0.086mSv/y while the same parameter for sediments samples was 0.1mSv/y and 0.067mSv/y respectively in the two areas. The mean hazard index (Hex) obtained for rock samples from both Olkaria geothermal and control site samples were found to be 0.47 and 0.42 while the mean for sediments for samples from the two sites were found to be 0.47 and 0.32. From the obtained results, the studied hazard indices were below the world acceptable safety limits and therefore human exposure to radiation is within safety levels. This shows that the exploitation of geothermal energy in Olkaria has not affected the activity concentration level of ^{238}U, ^{232}Th and ^{40}K and the hazard indices.