

Determination of Naturally Occurring Radioactive Elements and Radiation Exposure Levels in the Soapstone Quarries of Tabaka Region of Kisii District, Kenya

Vincent Otworri Atambo

A thesis submitted in partial fulfillment for the Degree of Master of Science in Physics in the Jomo Kenyatta University of Agriculture and Technology

2011

ABSTRACT

A radiological study was carried out in the soapstone quarries of Tabaka region of Kisii district in the Southern Nyanza province, Kenya, where soapstone is mined and used as a carving medium. In this study, 14 soil and rock samples collected from five quarries were analyzed using high-resolution gamma-ray spectroscopy. The absorbed dose rates were measured 1 metre above the ground at each quarry using a model 2000 Canberra radiagem. Various radionuclides were identified in the samples. The activity concentrations of radionuclides ^{232}Th , ^{40}K and ^{226}Ra in the samples as well as other radiological parameters were determined. The activity concentrations for ^{232}Th ranged from 38.60 to 271.70 Bqkg^{-1} , ^{226}Ra ranged from 43.10 to 360.00 Bqkg^{-1} and ^{40}K ranged from 245.00 to 1780.00 Bqkg^{-1} . The average absorbed dose rate for the five quarries measured 1 metre above the ground was 541.40 nGyh^{-1} . The calculated absorbed dose rates were found to be in the range of 87.49 to 356.77 nGyh^{-1} , with an overall average value of 183.79 nGyh^{-1} which was 4 times higher than the world average (43 nGyh^{-1}). The corresponding annual effective dose rates due to the radionuclides ^{232}Th , ^{226}Ra and ^{40}K in the quarries ranged from 0.22 to 0.88 mSvy^{-1} , with a mean of 0.44 mSvy^{-1} , assuming a 40% occupancy factor. Both the internal and external hazard indices were found to be more than unity (1.02 and 1.28 respectively), hence exceeding the permissible limits set by International Commission on Radiological Protection, 2000. The annual effective dose in the quarries was less than 1 mSvy^{-1} , the limit acceptable for the public.