Title: **Assessment of natural radioactivity levels and radiation risk due to the different rock types in the Kerio Valley region of Kenya**

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Abstract: Natural radioactivity levels and radiation risks due to different rock types in the Kerio Valley region of Kenya have been measured. Kerio Valley is one of the regions in Kenya suspected to be a high background radiation area (HBRA). This region is rocky and is occupationally characterized by quarrying activities of the various rocks for construction purposes both in the valley and neighbouring towns. All rocks are known to contain natural radionuclides of the 238U and 232Th series, as well as 4oK. The goal of this study was to analyse the natural radioactivity levels and distribution of natural radionuclides as well as assess the contribution of different rock types to the ambient gamma ray dose in the Kerio Valley region. The activity concentration levels of natural radionuclides (uranium, thorium, potassium) in rock samples were analysed using NaI(Tl) gamma ray spectrometry method. The associated radiological parameters (radium equivalent activity, external hazard index, dose rates) were calculated based on the obtained activity concentrations. The resulting activity concentrations were investigated by principal component analysis (peA) and hierarchical cluster analysis (HeA) to observe the nature of the association of the radionuclides and to identify the distribution patterns of the radionuclides in different subregions as well as to correlate radionuclides with the rock types. This would uniquely define the sources of HBRA in the region as well as provide regulatory information on the selection and use of rocks for construction in the Kerio Valley region. The activity concentration varied from 72.707±58.470 Bqkg-' (sandstone) to 116.l49±31.463 Bqkg' (marble) for 238U; 40.317±34.481 Bqkg' (limestone) to 83.652± 59.912 Bqkg-' (gneiss) for 232Th and 427.408±408 Bqkg-' (marble) to 1397.238±265.265 Bqkg' (granite) for 40K. For all the rock samples and' types, the activity concentration exceeded significantly the world average of 33 Bqkg-', 45 Bq/kg and 400 Bqkg' for 238U, 232Th and 4oK, respectively. The hazard indices were computed and used to determine the suitability of the rocks for building in the context of radiological hazard posed. The results obtained for the radium equivalent activity and the external hazard index show that all the rock types do not exceed the recommended limit of370 Bqkg-' and 1, respectively. The outdoor absorbed dose rate calculated ranged from 90.585 nGyh-' (limestone) to 159.085 nG/h (quartzite) while the indoor absorbed dose rate ranged from 66.696 nGyh-'(limestone) to 157.442 nGyh' (quartzite). These values for absorbed dose rate were above the world average value of 60nGy'". The annual effective dose rate for all the rocks did not exceed the recommended limit of 1mSvy". Principal component analysis results show clustering of sampling sites based on rock types, which mean that the activity concentration of radionuclides in rocks from Kerio Valley depends on the type of rock as a result of the chemical and mineral composition of these rocks. Hierarchical cluster analysis technique (HeA) results showed different areas are distinguished in terms of average activity concentration of natural radionuclides with areas (sub regions) with close levels forming clusters. Rocks from areas to the southern part of the Valley (Kabiemit and Soy) where mining of fluorspar is done were found to have elevated activity

concentration of all the measured radionuclides than other areas which are characterized by relatively low activity concentration.