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DOSE RATE PREDICTIVE MODEL OF TERRESTRIAL GAMMA RADIATION BASED ON SUPERFICIAL-WEATHERED SOIL AND ROCKS: CASE STUDY IN SARAWAK, MALAYSIA

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ABSTRACT

Estimating terrestrial gamma radiation (TGR) levels is crucial for assessing the annual effective dose received by the public due to natural radiation exposure. Cumulative doses from various sources can become significant, warranting a spatial understanding of TGR distribution. Few countries have comprehensively mapped TGR on a national scale, often facing challenges due to remote or inaccessible regions. This study explores the feasibility of estimating TGR dose rates using a linear regression model based on surface-weathered soils and rocks in Sarawak, Borneo, Malaysia. Geological studies reported that a rich diversity of rock types shaped by complex tectonic history can be found in Sarawak, predominantly sedimentary rocks covering 93% of the region, while igneous and metamorphic rocks constitute the remaining 7%. In this study, a total of 1044 TGR dose rate measurements were collected. The measurement ranges from 7 to 320 nGy h-1, with a mean of 100 nGy h-1.. Non-parametric statistical analyses of variance have validated the notable dissimilarities among six categories of superficial-weathered soil and distinguished the two distinct groupings of sedimentary and igneous rocks. The regression analysis produced a model for predicting TGR dose rates (nGy h^{-1}) = 0.992Dsoil – 0.816Drock + 109. The model showed a sufficient linear correlation, with spatial maps generated from in-situ measurements and the regression model displaying similar regional dose rate contours. Semivariogram analysis supported the model's reliability for predicting TGR dose rates in areas with similar geological backgrounds. In conclusion, this study has successfully developed a predictive model for TGR dose rates in Sarawak, based on superficial-weathered soil and rock data. While the model is specific to the Sundaland-Borneo tectonic block, it provides a valuable tool for spatial inference of TGR dose rates in unsampled locations with similar geological characteristics, aiding in radiation exposure assessment and environmental monitoring.

Keywords:Terrestrial gamma radiation, spatial dose mapping, background radiation, soil-rock gamma dose rate.