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Image processing techniques revealing the relationship between the field-measured ambient gamma dose equivalent rate and geological conditions at a granitic area, Velence Mountains, Hungary

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In order to estimate the annual dose that the public receive from natural radioactivity, the identification of the potential risk areas is required which, in turn, necessitates understanding the relationship between the spatial distribution of natural radioactivity and the geogenic risk factors (e.g., rock types, dykes, faults, soil conditions, etc.). A detailed spatial analysis of ambient gamma dose equivalent rate was performed in the western side of Velence Mountains, the largest outcropped granitic area in Hungary. In order to assess the role of local geology in the spatial distribution of ambient gamma dose rates, field measurements were carried out at ground level at 300 sites along a 250 m x 250 m regular grid in a total surface of 14.7 km2. Digital image processing methods were applied to identify anomalies, heterogeneities and spatial patterns in the measured gamma dose rates, including local maxima and minima determination, digital cross sections, gradient magnitude and gradient direction, second derivative profile curvature, local variability, lineament density, 2D autocorrelation and directional variogram analyses.

Statistical inference showed that different gamma dose rate levels are associated with the rock types (i.e. Carboniferous granite, Pleistocene colluvial, proluvial, deluvial sediments and talus, and Pannonian sand and pebble), with the highest level on the Carboniferous granite including outlying values. Moreover, digital image processing revealed that linear gamma dose rate spatial features are parallel to the SW-NE dyke system and possibly to the NW-SE main fractures. The results of this study underline the importance of understanding the role of geogenic risk factors influencing the ambient gamma dose rate received by public. The study also demonstrates the power of the image processing techniques for the identification of spatial pattern in field-measured geogenic radiation.