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RADIOLOGICAL IMPLICATION DUE TO HEAVY MINERALS IN SURFACE SOIL FROM DITRAU MASSIF –EASTERN CARPATHIANS, ROMANIA

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The mineralogical analysis of 70 soil samples collected in relation to type of parent rock has been carried out using X-ray diffraction analysis. In addition to the major minerals observed (quartz, albite, microcline feldspar, illite), XRD analysis revealed the presence of heavy minerals such as: monazite, thorite, thorianite, pyrochlore, zircon, titanite, rutile, ilmenite. The mineralogy of soil reflected the composition of typical alkaline rocks from Ditrău Massif (syenite, nepheline syenite, granitoid, hornblendite, diorite and monzonite).

The concentrations of natural radionuclides in same surface soil samples were determined by a gamma ray spectrometer using the HPGe detector with 27% relative efficiency. The gamma absorbed dose rates in air was estimated through calculation from the activity concentration of ²³⁸U, ²³²Th, and ⁴⁰K isotopes present in soil. The ²³²Th activity is distinctly higher than ²³⁸U and it ranges from 8.12 to 208.28 Bq Kg⁻¹ with a mean activity of 58.8 Bq Kg⁻¹. The ²³⁸U concentration ranges from 23.86 to 114.86 Bq Kg⁻¹ with a mean activity of 36.8 and ⁴⁰K concentration ranges from 38.14 to 1340.14 Bq Kg⁻¹ with a mean of 476.12 Bq Kg⁻¹. All radionuclides concentrations fitted to the log normal distribution indicating higher the radioactivity of the massif. The individual radionuclide concentration, especially thorium and uranium, shows a positive correlation with the proportion of heavy minerals determined for the surface soil samples which indicates the variability of geological formation for the Ditrau Massif.

The world average for absorbed dose rate is 51 n Gyh⁻¹ whereas in the present survey the average outdoor gamma dose for soil ranged from 23.38 to 230.211 n Gyh⁻¹ with a mean value of 71.251 n Gyh⁻¹ which is much higher than global value. The annual effective dose calculated in the environment to the population was values ranged from 0.028 to 0.28 mSv y⁻¹ with a mean value 0.08, which is similar to 0.07 mSv y⁻¹ given in UNSCEAR report as the worldwide representative value. Although the mean value is comparable to the global average there are some points in the massif area associated with presence of REE+ Th+ U mineralizations where the annual effective dose has high values.

The external hazard indices (H_{ex}) calculated for the soil samples studied ranged between 0.14 and 1.37 with an average value of 0.41. Most of H_{ex} values are in according to the criterion limit (H_{ex} ≤ 1 to keep the radiation hazard insignificant to the people) as per European Commission of Radiation Protection reports.

