

Natural radioactivity level in stream sediments of Grădiştea River: source identification and radiological risk assessment

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The naturally occurring radionuclides (²³⁸U, ²³²Th and ⁴⁰K) in stream sediments of the Grădiştea River (upper sector) were investigated to identify the primary sources, transport pathways, and geochemical conditions favoring their mobilization and concentration in the existing geologic environment. Furthermore, this study evaluates the radiological risk generated by exploration for REE(Y), Zr, Sn, Th and U in the Grădiştea de Munte area.

The study area is located in the Şureanu Mountains, part of the Getic Crystalline. Mineralisation can be found in the Upper Proterozoic Sebeş-Lotru Series composed of mesometamorphic rocks (micaschists, quartz-feldspat gneisses, amphibolites and amphibolite schists, and migmatized paragneisses)[1-2]. Magnetite and zircon are major mineralization phases whereas the rare elements (Nb, Ta, REE(Y), Zr, Sn, Th and U) occur as accessory phases in oxide, carbonate, phosphate, and silicate forms [1].

²³⁸U, ²³²Th and ⁴⁰K concentrations in 20 stream sediments samples were measured non-destructively using gamma-ray spectrometry, using a HPGe detector. The mineralogical composition of the sediments was studied using scanning electron microscopy.

U-238 specific activity in the stream sediments varies between 49.8. and 522.9 Bq/Kg and Th-232 specific activity from 8.12 to 89.28 Bq/Kg, whereas the K-40 specific activity ranges from 20.03 to 690.2 Bq/Kg. These values reflect geological settings and influences of mining practices and tipping of rock waste. The highest levels of U in stream sediments are found in samples collected from the Pustiosu brook in the vicinity of the rocks dump, whereas Th has maximal values in the upper course of the Jerosu brook where mineralization is observed in outcrops in the middle of the stream.. The mineralogical study of stream sediments reveals that thorite, monazite, alanite, urano-thorianite, xenotime, zircon, apatite, rutile and titanite are the most important Th and U bearing minerals.

The UNSCEAR recommended global average absorbed gamma radiation rate (84 nGy*h⁻¹) is surpassed in the vicinity of waste-rock dumps. The estimated values of the radiological hazard parameters follow the same pattern.

References:

[1] Hirtopanu, P. & Fairhurst R. J. (2014) s. Rom. J. Mineral Deposits (87), (1), 53 – 56

[2] Nica D.B. et al. (2009) GEO-ECO-MARINA, (5), 117-122