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Polonium (210Po), lead (210Pb) and uranium (234U, 235U, 238U) contamination of environment surrounding phosphogypsum waste heap in Wiślinka (northern Poland).

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The aim of this study was to examine the concentrations of 210Po, 210Pb, 234U, 235U and 238U in surface soils samples collected in the area of phosphogypsum waste heap in Wiślinka (northern Poland) and assessing its impact on the surrounding environment. Concentrations in analyzed soils samples were estimated between 3.0±0.2 mBq•g-1 dry wt. and 324.5±15.41 mBq•g-1 dry wt. for 210Po and between 3.6±0.2 mBq•g-1 dry wt. and 229.9±5.4 mBq•g-1 dry wt. for 210Pb. 210Po/210Pb activity ratios were in the range of 0.70±0.05 to 2.15±0.13. The abbreviation may be connected with the agricultural use of fertilizers. The results for uranium suggest that 234U, 235U and 238U radioisotopes that are present in the vicinity of phosphogypsum waste heap are of natural origin (234U/238U activity ratio between 0.81±0.08 and 1.22±0.11, and 235U/238U between 0.029±0.008 and 0.062±0.013 are typical for soils). The activities of 238U,234U and 235U ranged from 2.20±0.17 mBq•g-1 dry wt. to 108.68±3.03 mBq•g-1 dry wt., from 2.31±0.17 mBq•g-1 dry wt. to 108.68±3.03 mBq•g-1 dry wt. and from 0.08±0.03 mBq•g-1 dry wt. to 3.88±0.57 mBq•g-1 dry wt., respectively. The highest activities of 210Po and 210Pb were measured in samples collected on both slope and bottom of the phosphogypsum heap. Much lower results were obtained for samples collected from distant areas, what is probably connected with both erosion and leakages from phosphogypsum waste heap into surrounding environment. Lower results for 234U and 238U in the vicinity of phosphogypsum stack in comparison to 210Po and 210Pb activities in this area may be explained by the fact that during the process of phosphoric acid production polonium migrates to phosphogypsum fraction and uranium to phosphoric acid. It is connected to higher solubility of uranium in phosphates. Surprisingly, the highest concentrations of uranium radioisotopes were measured in samples collected from more distant sample collection sites. This fact must be correlated with the use of phosphoric fertilizers in agriculture. For a clearer picture of the radioactive contamination of the area of phosphogypsum waste heap in Wiślinka, we decided to create interpolation maps for every radioisotope using natural neighbor interpolation and ordinary kriging geostatistical method in Spatial Analysis and Decission Assistance (SADA) software. This allowed us to isolate zones that are categorized by different activities of 210Po, 210Pb, 234U, 235U and 238U: the foot of the waste heap, the slopes of the waste heap, agricultural fields and the opposite riverbank of Martwa Wisła river. Additionally, we plotted graphs that described analyzed radioisotopes distribution on the distance from the phosphogypsum landfill. This helped us to isolate the zone described by the highest activities of uranium, polonium and lead radioisotopes.
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