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A new challange in drinking water supply - Radionuclide content of groundwater in flow system context

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Groundwater is a very common drinking water source. Radioactivity of groundwater, as a possible threat and its hydrogeological background had not been widely investigated until recently. Soluble members of the uranium decay chain such as uranium, radium and radon are highly important in this context. Isotopes entering the pore water during the radioactive decay can be transported by the groundwater flow. Their distribution is affected by characteristics such as pH, redox potential and chemical composition of the groundwater. Uranium can be mobilised in oxidizing and radium in reducing environment. These parameters can vary with the type of the flow regime. Recharge areas and discharge points of local flow systems are characterised by oxidizing environment while discharge areas of higher order systems tend to be reducing. Therefore areal variability of the natural radioactivity of the groundwater is affected by the flow regimes along with geological features. In Hungary 97% of the potable water is sourced from groundwater. Following the Euratom Drinking Water Directive the radioactivity of drinking water is screened in Hungary by total alpha and total beta activity measurements. Whenever the measured concentrations surpass the limit values the long term consumption of the water can lead to health issues. Based on data provided by the National Public Health Institute high values of total alpha activity can be found in the southern foreland of Lake Velence. Therefore, uranium, radium and radon concentration measurements were carried out in the wider area and interpreted in flow system context. The samples were taken from surface water bodies as well as from groundwater. Alpha spectrometry applied on Nucfilm discs was used to measure the uranium and radium activity while radon activity was determined by TriCarb 1000 TR liquid scintillation detection. Pressure-elevation (p(z)) profiles were compiled to understand the flow regime. The areal distribution of the activity concentration values were interpreted regarding the groundwater flow system, physico-chemical parameters measured onsite and in the laboratory. Hydraulic data evaluation using pressure-elevation profiles are powerful and easy methods to determine the vertical flow conditions of an area since it is based on archival well documentation available in public institutions. Those areas can be delineated where according to the flow conditions and the related geochemical environment the mobility of the uranium or radium and thus elevated activity concentration can be expected in groundwater, where natural geological background exists. This novel approach may facilitate safe water management of drinking water supply systems.

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