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Radionuclides in groundwater flow systems – case studies from drinking water supply systems in Hungary

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Uranium, radium and radon are usually found in groundwater. Using these radionuclides is a novel approach to characterize fluids of groundwater flow systems and understand mixing processes. Particularly, in regional discharge areas, where different order flow systems convey waters with different temperature, composition and redox-state to the discharge zone. Radium and uranium are redox-sensitive parameters, which causes fractionation along groundwater flow paths. Discharging waters of regional flow systems are characterized by elevated total dissolved solid content (TDS), temperature, reducing conditions, and therefore with negligible uranium content. Whereas local flow systems have lower TDS and temperature and represent oxidizing environments, and therefore their radium content is low. Due to the short transit time, radon may appear in local systems' discharge, where its source is the soil zone. However, our studies revealed the importance of FeOOH precipitates as local radon sources throughout the adsorption of radium, which is transported by the waters of regional flow systems. These precipitates can either form by direct oxidizing of waters at the discharge zone, or by mixing of waters with different redox state. Therefore elevated radon content often occurs in regional discharge areas as well. Since 2016 the measurement of radioactivity of springs and wells is compulsory in groundwater monitoring in those cases, when they are used for drinking water supply. In our study we present case studies from Hungary, where the understanding of groundwater flow systems helped to explain the occurrence of radionuclides in these systems.
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