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Isotopic Analysis As an Indicator of the Groundwater Stability

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Natural radionuclides can be very good indicators of all hydrological and biogeochemical phenomena occurring in the water environment. Typical uses of environmental isotopes include the identification of source of water and solutes, determination of water flow paths, assessment of nutrients within the ecosystem, water budget. A few elements exhibit variations in their isotopic composition, resulting from radioactive decay its precursors present in the geological formations. These isotopic ratio variations can be used as natural fingerprint of rock –water interaction and applied in weathering and hydrology studies.

In this work activity ratio of uranium and radium isotopes ($^{234}\text{U}/^{238}\text{U}$, $^{228}\text{Ra}/^{226}\text{Ra}$), as well as of the stable strontium isotopic ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) were determined in selected thermal groundwater, ground and surface water samples from central Poland. Uranium isotopes after co-precipitation with hydrated manganese dioxide were separated from other natural radionuclides by extraction chromatography resin (Dowex 1x8). The activity concentrations were determined by using α spectrometry with PIPS detector (Canberra). ^{228}Ra was determined by gamma spectrometry after co-precipitation with MnO_2 , whereas ^{226}Ra was determined by liquid scintillation counting. Strontium isotopic ratio after separation from other element by extraction chromatography resin (Dowex 50Wx8) was determined by thermal ionization mass spectrometry (TIMS).

The average isotopic ratio for different type of water sample from Poddebice and Uniejow was shown in the Table 1.

Table 1 Activity and isotopic ratio in different type water.

location water type

$^{234}\text{U}/^{238}\text{U}$ $^{228}\text{Ra}/^{226}\text{Ra}$ $^{87}\text{Sr}/^{86}\text{Sr}$

Poddebice thermal groundwater $0,923\pm 0,020$ $1,64\pm 0,35$ $0,708492\pm 0,000014$

deep well water $1,115\pm 0,063$ $1,23\pm 0,71$ $0,709454\pm 0,000130$

river water $1,027\pm 0,116$ $2,67\pm 1,14$ $0,709718\pm 0,000466$

Uniejow thermal groundwater $0,744\pm 0,094$ $0,641\pm 0,043$ $0,708441\pm 0,000002$

river water $1,232\pm 0,161$ $1,95\pm 0,49$ $0,709256\pm 0,000059$

The observed differences in these ratios confirms that the uranium, radium and strontium isotopic ratio can be useful indicator for determination of stability of the underground water reservoirs.

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