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# Interaction between recent infiltration waters and diagenetic waters in the Wysowa Spa region, southern Poland: insights from combined isotope and geochemical study

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The Wysowa Spa is located in southern Poland, in the upper reaches of the Ropa river draining part of the Beskid Niski mountain range. The catchment of Ropa river is underlain by Paleogene-Cretaceous flysch formations covered by Quaternary deposits. Mineral and therapeutic $CO_2$-rich waters occur in the central part of Wysowa Spa. They are exploited from depth interval of ca. 15 to 100 m by eleven wells distributed over the area of ca. 0.28 $km^2$.

The exploited mineral waters are mixed waters containing two major components in varying proportions. One end-member is represented by highly mineralized diagenetic water of deep circulation, reaching the surface through system of fissures and faults. This end-member, represented by water from Aleksandra well, is enriched in $Cl^-$ and $Na^+$ ions and contains geogenic carbon dioxide. Maximum concentration of dissolved $CO_2$ exceeds 3100 mg/$dm^3$ and $HCO_3^-$ ions – 12850 mg/$dm^3$ [1]. The second end-member is represented by recent water of local infiltration.

Isotope and chemical investigations of mineral waters in the Wysowa Spa region started in 1970s [2-3]. The recent ongoing study comprised analyses of full isotopic composition of water (tritium content, $\delta^2$H, $\delta^{18}$O and $\delta^{17}$O) and water chemistry in all eleven wells. The diagenetic end-member (Aleksandra well) has characteristic stable isotope composition ($\delta^2$H = -30.15±0.08‰ $\delta^{18}$O = 6.62±0.02‰ $\delta^{17}$O = 3.47±0.02‰) and is devoid of tritium. The recent infiltration end-member (wells W-3 and R-1) reveal high and variable tritium levels and their stable isotope composition ($\delta^2$H = -70.02±0.04‰ $\delta^{18}$O= -10.24±0.02‰ $\delta^{17}$O= -5.40±0.01‰) reflects isotopic signatures of local precipitation.

The end-members define a mixing line in the $\delta^2$H-$\delta^{18}$O space. Isotope data for the remaining eight well tightly cluster along this line confirming strong interaction between recent infiltration waters and diagenetic waters in the study area. Also, a strong linear relationship is observed between stable isotope composition and chloride concentration in all studied wells further supporting the occurrence of two-component mixing. A mixing pattern is also apparent when $\Delta^{17}$O parameter is plotted as a function of ln($\delta^{18}$O+1); $\Delta^{17}$O gradually decreases from ca. 25 per meg for recent infiltration component, down to approximately -20 per meg measured in Aleksandra well. It is not clear at the moment why the diagenetic water reveals distinctly lower $\Delta^{17}$O values when compared to recent infiltration water.

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