Isotopes as tracer for groundwater – surface water – mine water interactions in post-mining environments: the case study of Zlatna mining area (Romania)

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The stable isotope composition of water is used as a natural tracer for assessing the circulation of mine water, the mixing of different underground sources, as well as their interaction with surface water. The study is part of the SUSMIN project (CCCDI – UEFISCDI 3004/2014) which pursues the enhancement of environmentally sustainable mining by evaluating new methods for modelling reactions and pathways of contaminants relative to geogenic background.

In Zlatna gold mining area (Apuseni Mountains, Romania) the extraction activities were completely abandoned in 2007. Presently, the mine openings are secured, but significant flow of acid mine water continues to discharge into the river system.

Water samples (running water, springs, domestic wells, and mine water) were collected on a monthly basis from January to December 2015. Sources of running water were sampled both upstream of the discharge point of mine water and downstream.

Linear correlation between δD and $\delta^{18}O$ values indicates that all water sources belong to the meteoric cycle. Correlations between the δD and TDS values show underground mixing phenomena between different water sources. For most mine water sources no significant seasonal variations of the δD, $\delta^{18}O$, pH and TDS values was recorded, indicating well-mixed underground systems and slow flow recharge pathways. Other mine water sources show seasonal variations of these parameters suggesting continuous recharge of mine water and a fast underground circulation.

No relevant contamination of springs and phreatic water by mine water could be revealed, suggesting different underground pathways for the two types of water. On the contrary, running water is contaminated by mine water discharges. The negative effects of acid mine water occur mainly in the summer months when the flow of the running water decreases.