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Hydrogeochemical impacts of high water events on a karst system: A multi-tracer reaction-path and mixing model

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Modern karst ground water systems are at the cutting edge between anthroposphere, hydrosphere, and geosphere. The hydrogeochemical processes in karst terrains are sensitive both to climate change and anthropogenic activity. They often provide reservoirs for drinking water. Therefore, understanding the hydrogeochemistry of interactions between surface and ground waters is of fundamental importance.

We present results from a hydrogeochemical study of the impact of river high waters on one of the largest European karst springs, the Rhume spring, at the south west margin of the Harz Mountains (Germany). Besides the karst spring also the response of well waters in the recharge area is considered. Results from natural (snow-melt induced) high waters are compared to an artificial high water induced during summer time.

Rivers from the Harz Mountains are partially infiltrating Quaternary strata and emerging, after a passage through Permian (Zechstein) carbonate and sulfate rocks at the Rhume spring. The amount of infiltrating water and the underground flow velocities depend on the hydrological conditions: In response to high water conditions at the rivers the discharge of the karst springs increases and the mineralization decreases due to reduced time for water-rock interactions and changing mixing ratios with old mineralized karst waters. Using a multi-tracer approach (trace elements: F-, Sr^2+, Ba^2+), major and minor elements (Ca^2+, Mg^2+, SO_4^2-, HCO_3-, Cl-, NO_3-, O_2, K+, Na+), and stable isotopes (S-34, O-18, C-13) we were able to carry out a reaction-path analysis of water-rock-gas phase interactions and, especially, to quantify the amount of an old

mineralized ground water component mixing continuously into younger waters that are influenced by recent high water events.