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Hydrogeochemical modeling of alteration processes in the Ringelbach granitic research catchment (Vosges, France)

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The main goal of this work is to better constrain the parameters that control weathering processes at a small catchment scale, focusing specifically on the role of hydrology. For this purpose, temporal and spatial variations of the chemical water composition of the Ringelbach catchment (Vosges, France) are studied. Several springs of this catchment whose basement is composed of a more or less intensively fractured granite, outcropping along an altitudinal profile, were monthly sampled over a period of two years. The additional interest of this site is that three deep boreholes (down to a maximal depth of 150 meters) allow the sampling of both deep rocks and waters. The connectivity of the different hydrological compartments is evaluated based on the geochemical interpretation of water samples. A schematic hydrological functioning is proposed based on a good knowledge of the geological context. The originality of this study lays also in the combination of the geochemical and modeling approaches using the KIRMAT code (Kinetic Reactions and Mass transport) which integrates geochemical reactions (dissolution/precipitation) and 1D mass transport equations. It allows to simulate the reactive transport of a fluid through a rock along a given water pathway. This modeling is based on the characterization of the mineralogical and physical properties of the rock, sampled along the boreholes and leads to the geochemical interpretation of the water composition. Thus, the modeling of the chemical composition of the spring waters and borehole waters enables to improve the understanding of weathering processes including the role of precipitated secondary phases. It also allows to better understand the interplay of parameters that control the chemical signatures of the waters at the catchment scale.