Geophysical Research Abstracts
Vol. 14, EGU2012-10637, 2012
EGU General Assembly 2012

Geochemical tracing and modeling of alteration processes in the Ringelbach granitic research catchment (Vosges, France)

T. Schaffhauser, F. Chabaux, B. Fritz, B. Ambroise, A. Clement, and Y. Lucas
LHyGeS, Université de Strasbourg, Strasbourg, France (thiebaud.schaffhauser@etu.unistra.fr)

For constraining the nature of water-rock interactions occuring within granitic watersheds a geochemical study combined with a modeling approach has been undertaken in the Ringelbach granitic catchment (Vosges, France). Concentrations of major elements in water were regularly measured in main springs (subsurface water) and in two 150-m deep boreholes (deep water).

Water chemical composition varies largely whitin the watershed. The data indicates that the intensity of water-rock interactions increases when the elevation of the spring decreases. It is maximal for deep borehole water (highest pH, alkalinity and concentrations values). Springs show important seasonal geochemical variations, which cannot be accounted for by simple variable contributions of rainwater. Furthermore, geochemical variations in subsuface waters cannot be explained by variable contributions of deep water particularly during low flow periods in a mixing model.

The coupled transport/reaction model KIRMAT allows us to discuss and constrain the origin of chemical variations of catchment waters. It combines geochemical reactions and 1D mass transport equations to simulate the reactive transport of a fluid through a rock along a given water pathway. It incorporates also ideal solid solutions for simulating the precipitation of clay minerals. In the case of the Ringelbach catchment, the model simulates the transfer of rainwaters along different water pathways crossing the different weathering levels of the granitic bedrock, from very permeable surficial arenic formation to almost impermeable deep fresh granite. As confirmed using a simple hydrological model (COMSOL), the annual water flow, which accumulates progressively downslope to relatively high rates, occurs mainly along a subsurface pathway, the contribution of deep groundwater being very small.

Simulations confirm that the initial chemical signature of rainwater is rapidly lost due to the weathering of rock-forming minerals. The water chemistry simulated for high-rate downslope subsurface flow is consistent with the observed spring water chemistry. The spatial and temporal variability of spring water is therefore essentially controlled by water pathways and duration of water-rock interactions.