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Particles in a karstic spring, Swabian Alb: Physicochemical and hydraulic effects during a snow melt event.

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The studied karst spring 'Gallusquelle' is located on the Swabian Alb in Southwest Germany. The catchment area of the 'Gallusquelle' measures about 45 km^2. An average annual discharge of 0.5 m^3/s serves drinking water to about 40,000 people via a waterworks. The study is part of the research project 'AGRO' (www.projekt-agro.de). The main objective of the project 'AGRO' is to develop a tool for the process-based risk management of micropollutants and pathogens in rural karst aquifers on catchment scale.

As particle related transport could play an important role for micropollutants and pathogens, the characterization of particles in the spring water is one focus of this work. Furthermore we will attempt to correlate physicochemical parameters with the characteristics of particles in the spring water in order to enhance the knowledge of the transport mechanisms within the karst aquifer.

For the measurement of the particle concentration and the particle size distribution the CIS 1 (GALAI) was used. The system works in a range of 0.5 to 150 μm with a resolution of at least 0.5 μm. The measurement is based on time-of-transition method using a laser beam. The turbidity was measured with an ULTRATURB PLUS (DR.LANGE) and a Fluorometer (GGUN-FL30, ALBILLIA), both working with scattering light method. To verify these measurements we used a portable turbidimeter (2100P IS PORTABLE TURBIDIMETER, HACH) working with the ratio of the signals from the scattered and the transmitted light. Temperature and electrical conductivity where also measured with the GGUN-FL30, whereby the electrical conductivity was verified with a portable multimeter (HQ 40D, HACH). Discharge, pH, water hardness, anion- and cation concentration, total organic carbon (TOC) and dissolved organic carbon (DOC) were also determined.

To characterize the particles, the spring water was filtered onsite and the filter cake was analyzed in the laboratory. For SEM (scanning electron microscopy) including EDAX (energy dispersive X-ray spectroscopy) the water was filtered through PC membrane filters (∅=25mm) using a polycarbonate syringe. For X-ray diffraction the water was filtered through CA membrane filters (∅=142 mm) using a stainless steel pressure holder and a peristaltic pump. Both filters had an average pore size of 0.45 μm. Also we have analyzed sediments that where collected downstream of the online measurements and in the raw water tank of a waterworks that is located about 250 m downstream of the spring.

During an average discharge the turbidity and the number of particles are around the limit of detection. Both increase with increasing discharge while the average particle size does not increase until a considerably higher-than-average discharge is reached. Particles in the size range of 0.5 – 2.0 μm display the main numeric amount (70 – 100 %) of the measurable particles under present discharge conditions. Only under high discharge conditions particles sizes > 5 μm increase significantly. Particles > 20 μm are rare during the whole period of measurement.

In contrast to other works we include mineralogical studies of the particles in the spring water. Thus we can examine the relevance of mineralogical properties of the particles for the transport of micropollutants. Actual results of XRD analyses indicate that calcite, quartz and clay minerals dominate the turbidity. EDAX analyses with SEM confirm these measurements.