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The use of environmental isotopes for event monitoring at an overthrusted karst aquifer in the Dinarides, north-western Croatia.

Philipp Stadler (1), Albrecht Leis (2), Hermann Stadler (2), and Hermann Häusler (1)

(1) University of Vienna, Department of Environmental Geosciences, Althanstrasse 14, A-1090 Vienna/Austria, philipp.stadler@gmx.at, (2) Joanneum Research, Institute for Water, Energy and Sustainability, Department for Water Resources Management, Elisabethstrasse 16/I, A-8010 Graz/Austria, albrecht.leis@joanneum.at

The research area is located in the Gorski Kotar, a southeast tending green karst mountain range in north-western Croatia with altitudes between 1000 and 1200 metres, which is well known for big karst springs such as Kupa-, Kupica- and Zeleni Vir Spring. Geologically the region of the upper Kupa catchments belongs to the Outer Dinarides comprising mainly Paleozoic to Mesozoic formations. We follow the tectonic concept of Herak (1980), who identified Jurassic formations as karst aquifers below overthrusted confining Permotriassic formations (Biondić et al., 2006).
The aim of the hydrogeological investigations was to gain information about storage and discharge dynamics of a hidden karst aquifer, comparing the discharge of a karst spring with a surface runoff dominated creek. Hydrological information was gathered from an event monitoring by means of stable water isotopes. The isotopic composition of the water samples was measured in the laboratory by using cavity ring-down spectroscopy (Berden et al., 2001) with a WS-CRDS (Wavelength-Scanned Cavity Ring-Down Spectroscopy) instrument of Picarro, Inc. coupled to a CTC HTC-Pal liquid autosampler (LEAP Technologies, Carrboro, NC, USA) for automated measurements of liquid water samples. The instrumental setup of the system was recently described by Gupta et al. (2009).
Due to the framework of the project the realisation of an event monitoring of a heavy precipitation event in June 2010 was chosen, a well established method of isotopic investigations (Clark and Fritz, 1997). For taking representative samples during the event, a strategic position was chosen near the village of Skrad, east of Delnice that allowed both sampling a karst spring and a surface runoff dominated creek (discharging from the capping Permian clastic rocks). Samples were taken manually with an interval from one hour to three hours during the whole period of the event. Water temperature and conductivity were measured in shorter intervals. Runoff was measured with the tracer dilution method (Benischke and Harum, 1984) during decisive moments of the event. The local geological situation of an aquiclude covering the karstified aquifer results in special discharge and storage dynamics of the karst spring. In all samples taken during the 48 hours of monitoring from the small karst spring, no decisive precipitation influence (event water) was measured. This time lapse of at least 48 hours fits well with the general hydrogeological model, where the recharge area of the big karst spring of Zeleni Vir is situated approximately ten kilometres to the south, in the Ravna Gora, separated from the spring of Zeleni Vir by an aquiclude consisting of overthrusted Permotriassic formations. It allows also estimating an interspace velocity for the water of the local karst aquifer less than 5 cm/sec. Environmental isotope analyses show also, that the creek′s runoff is not only composed of surface runoff but also of spring waters. At the creek′s sample spot a time shift between the beginning of the discharge peak and the arrival of the precipitation's isotope signal occurred. The mentioned shift describes the influence of springs during rainfall events, leading to a difference between hydraulic reaction and the arrival of the event water. This dynamic seems similar to a piston flow model. Moreover the potential of WS-CRDS (Wavelength-Scanned Cavity Ring-Down Spectroscopy) for the creation of high quality isotopic data in hydrological studies was demonstrated.

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