The use of environmental isotopes for event monitoring

at an overthrusted karst aquifer in the Dinarides, north-western Croatia

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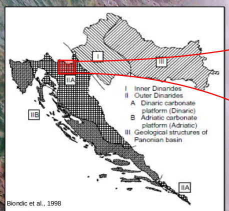
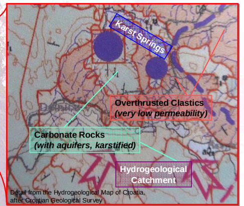
Research Area

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 1500 metres, which is well known for big Karst springs such as Kupa, Kupica and Zeleni Vir.





Fieldwork

- Rainfall event in June 2010 followed weeks of a rainless period.
- Sample campaign lasted 48 hours, covering the whole dynamics of the event.
- sample intervals from one to three hours.
- Discharge stage relation was calculated for the sample spots, discharge measurement: tracer dilution method.
- Strategic sample spots allowed parallel monitoring of a Karst spring and a surface runoff dominated creek.

Laboratory

Environmental isotopes of samples were measured using a Picarro Inc. Isotopic Water Analyzer combined with a CTC HTC-Pal autosampler (LEAP Technologies). This set up is similar to the one described by Gupta et al. (2009). The Picarro "Cavity Ring-Down Spectroscopy (CRDS)" uses a near-infrared laser to define δ18O and δ2H stable isotope ratios out of liquid water samples (Picarro Inc.). CRDS is a direct absorption technique (Berden et al., 2001) that offers results for pure water samples highly comparable in precision with classical mass spectroscopy (Brand et al., 2009).

Results

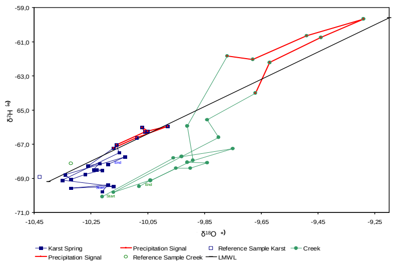


Fig 1: Course of isotope ratio during the monitoring.
Precipitation signal (marked red) shows the arrival of rainwater at the sample spot. The best fitting LMWL was taken from Vreca et al., 2006 ($\delta^2H = (7.6 \pm 0.4)\ \delta^{18}O + (10.5 \pm 4.0)$).

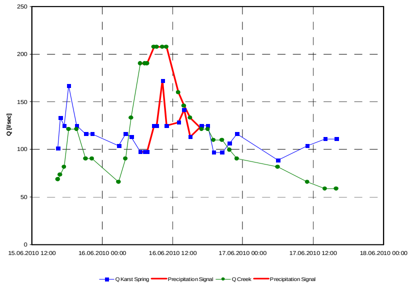
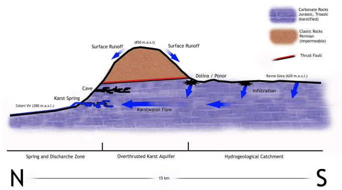


Fig 2: Discharge graph with precipitation signal.
red marking the arrival of rainwater at the sample spot.



Schematic profile-sketch
Showing the local hydrogeological model with an overthrusted karst aquifer, the hydrogeological catchment is seperatet from the spring zone by an aquiclude.

Conclusion

Creek

The peak of precipitation signal for both sample spots is marked red in Fig. 1. Isochronic values of discharge are also marked red in Fig. 2. It can be seen in Fig. 2, that there is a time shift between the beginning of the discharge peak and the arrival of the precipitation signal at the sample spot (Creek).

The creek's runoff is not only composed of surface runoff but also of spring waters. The mentioned shift shows 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.

Karst spring

- Shows a parallel but massively damped reaction on the event.
- No decisive precipitation influence (event water) during 48 hours of monitoring was measured.

This fits the general hydrogeological model (see profile-sketch) of a recharge area approximately 10 kilometres to the south.

- Estimated linear velocity in the local Karst aquifer less than 5cm/sec.

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