



Hydrogeologic investigations at an overthrust karst aquifer of the Outer Dinarides, Croatia

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The reported investigations are the result of a Master Thesis of Philipp Stadler performed at the Department for Environmental Geosciences, University of Vienna, during a two year's bilateral cooperation project with the Ruđer Bošković Institute in Zagreb (Wissenschaftlich-Technische Zusammenarbeit Project No.: H 05/2010, headed by Dr. Stanislav Frančišković-Bilinski, Zagreb, and by Univ.-Prof. Dr. Thilo Hofmann, University of Vienna).

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. East of Delnice the karstic spring "Zeleni Vir" is located below the village Skrad. The discharge of Zeleni Vir Spring ranges between 0.3 and 65 m³sec⁻¹ (Biondić et al., 2006) and is collected in a power plant's pressure pipe line. 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 overthrust and confining Permotriassic formations (Biondić et al., 2006). These conditions can be described as "hidden karst".

The aim of the work was to gain detailed information on the complex karst system around Zeleni Vir Spring. From the tectonic point of view the catchments of Zeleni Vir Spring can be described as a tectonic window, as the karstified Jurassic limestones are surrounded and overlain by (more or less impermeable) Paleozoic to Mesozoic formations. We applied detailed mapping of the geology and studying microtectonics of the Jurassic karst aquifer and of the overthrusted capping rocks, and gathered hydrological information from an event monitoring by means of stable water isotopes.

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 $\delta^{18}\text{O}$ and $\delta^2\text{H}$ 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).

At Zeleni Vir the discharge of a karst spring was compared with a surface runoff dominated creek. Water samples therefore were taken from Devils Creek and from a nearby streamlet which is donated by a smaller karst spring. The very specific discharge and storage dynamics of the local karst spring was studied during an event monitoring of heavy precipitation in June 2010 (Stadler et al., 2010). Combining this information with the local knowledge on permeable and impermeable formations enables us to set up a qualitative hydrogeological model. These investigations again show that structural geology is considerably affecting the karst hydrology of north-western Croatia because notable karst springs such as Kupa-, Rjecina- and Zeleni Vir Spring are related to fold- and fault structures of the Outer Dinarides.

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