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# Comparison of waters and sediments of Kupa River and Rjecina River rising under the same mountain range, but belonging to two distant watersheds (North-western Croatia)

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This work presents first complementary geochemical and stable isotope investigations of Risnjak Mountain karstic aquifer system in north-western Croatia. This aquifer is an important source of drinking water for both countries Croatia and Slovenia. The two main rivers, namely the Kupa River and the Rjecina River discharge the same mountain range, but belong to two different watersheds. Their springs are only 22 km apart, and located in scarcely populated areas. Kupa flows through limestones and dolomites in National Park Risnjak until it meets its largest tributary Cabranka. Rjecina flows first through flysch and carbonates before it enters the Adriatic Sea. At its lower course it flows through the densely populated town of Rijeka.
For effective management of water resources the baseline data were collected. Sediment fraction <63 $\mu$m was analyzed by ICP-MS on 52 elements. The values were compared with the existing sediment quality criteria. Continuous monitoring of Cr, Zn, As, Ba and Pb was recommended within the National Park Risnjak. Physico-chemical parameters (pH, electrical conductivity, dissolved oxygen and temperature) were measured in the field. Waters were analyzed in laboratory. Toxic elements (Cu, Cd, Pb and Zn) were determined by differential pulse anodic stripping voltametry (DPASV).
To understand the hydrodynamics of the karst groundwater system in Western Croatia detailed hydrogeologic investigations have been performed in the Rijeka catchments by B. Biondič (2000), and in the Kupa catchments by R. Biondič (2003). In addition Kapelj et al. (2002) and B. Biondič et al. (2006) investigated the isotopic composition of several springs in the Kupa- and Rječina catchments. To get a more detailed insight to hydrological processes in the drainage basins of Kupa River and Rječina River, and to compare both catchments of the Gorski Kotar, samples of some main springs and riverine waters were taken for stable isotope analysis. For the interpretation of isotope characteristics of precipitation in Croatia we refer to the comprehensive study of Vreča et al. (2006). Stable isotope composition was determined in waters during low and during high water conditions. Environmental isotopes of samples were measured at the University of Vienna, Department for Environmental Geosciences. The used set up of a Picarro Inc. Isotopic Water Analyzer combined with a CTC HTC-Pal autosampler (LEAP Technologies) 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$18O and $\delta$2H 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).
As in karstified regions such as Gorski Kotar the area of the hydrogeological catchments mostly exceeds that of the hydrological catchments, and because karst aquifers often are overlain by nearly impermeable formations, the time delay of discharge from major karst aquifers, and their stable isotope contents can hardly be interpreted without regular sampling of numerous groundwater sources. We conclude that the aquifer of Risnjak karstic mountain region contains water within drinking water quality standards. Continuous monitoring is suggested, especially of the Kupa Spring in National Park Risnjak and of the Zvir Spring in Rijeka due to some higher concentrations of trace elements, despite the fact that they are below MDK values.

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