Abstract

This study is focused on the flow through the uppermost part of the unsaturated zone in karstified areas. The information about distribution of transit times and chemical reactions taking place in the unsaturated zone is based on isotopic and chemical composition of cave dripwaters, precipitations and water caught by gravitation lysimeters. The water balance was calculated using measurements of intensity of dripwaters and amounts of water caught by lysimeters and rain gauges. The velocity of a hydraulic shockwave between monitored objects was also estimated according to the delay between significant precipitation event and dripwater intensity increase.

The field study took place in the Němcova 1 cave in the northern part of Moravian Karst, near the village Suchdol. It was carried out during the hydrological year 2010/2011. The cave is about 13 m under the surface. The information about composition of overlaying rock above the cave was obtained using geoelectrical and electromagnetic measurements.

Studied geological environment is built of 0.5 – 1.5 m of soil, 0.5 – 3.5 m of epikarst and a layer of massive limestone as thick as 10 m.

About 70 to 90 % of dripwaters have residence time over 4 years. The distribution of transit time of younger water can be described using the exponencial model (well mixed reservoir model) where the youngest water is the most abundant and the volume is decreasing with increasing transit time of water. The shortest transit times between the surface and the cave are about 200 days with 90 days through the first 35 cm and 110 days from the level 35 cm under the surface to the cave. The calculations of mean residence times between the monitored objects differed according to the particular type of model. The delay between the surface and the cave is 250 days using the exponential model, but 350 and even 480 days using a combination of exponential and piston flow model. The mean transit time between the surface and the lysimeter is 115 days and between the lysimeter and the cave it is 140 days. Surprisingly the water spends approximately the same time in the uppermost tens of cm of soil as in the underlying several meters of epikarst and rock.

Measurements were not frequent enough to allow an exact calculation of the velocity of hydraulic shockwave, but the increased activity of dripwaters was noticed 14 days after a significant precipitation event. A reaction of the lysimeter was delayed by a few days since the precipitation event.

The balance of chemical compounds in the water was complicated by lysimeter malfunctions and an unknown area of infiltration corresponding to the dripwaters. Therefore, the chemical composition was evaluated in terms of average concentrations in monitored objects and the changes during one hydrological year.