ABSTRACT

Moisture in a sandstone body plays a notable role in hydrological, weathering, biological and other processes. Knowledge about presence and movement of moisture within porous medium of natural sandstone exposures is, however, rather limited. Aim of the doctoral thesis was thus to quantify selected moisture characteristics of several natural sandstone exposures in Český ráj (Czech Republic).

According to long-term logging, mean annual temperature at studied areas was between 8.5 °C to 11.5 °C, mean annual relative humidity was between 73 % to 85 %. Deforested area was found warmer and drier and amplitude of the values was higher there than at the forested areas. Values of water content (more than 400 measurements) and suction (more than 150 measurements) of the exposures including their spatial-temporal changes were obtained. Mean volumetric water content in zone from the sandstone's surface to 12 cm depth was from 3 % to 10 % and mean suction in depth 2–12 cm was from 2 kPa to more than 130 kPa.

Using uranine powder coloring, spatial distribution of moisture near the sandstone's surface was visualized repeatedly for the first time. The coloring divided the surficial area of the sandstone into capillary (wet) and diffusion (dry) zone. The sharp transition between the two zones was represented by vaporization plane. The vaporization plane position varied from very surface to the depth of 9.5 cm, whereas the closer to the sandstone's surface in long-term average, the lesser the vaporization plane depth varied in time.

Based on direct measuring using evaporation apparatuses and on calculations by Fick's law, the evaporation rate from sandstone and its variability were obtained for the first time. The relative error of the calculations was from 9 % to 58 % of the measured value, which is acceptable error as observed evaporation rate varies over 3 orders of magnitude. Mean annual evaporation rate varied from 3 $mm \times year^{-1}$ to 245 $mm \times year^{-1}$. The most important factor controlling the evaporation rate was the vaporization plane depth below the surface. Then the season followed and the factor which controlled the evaporation rate least was the microclimate given by the location.

It was revealed that biologically-initiated rock crust affects some hydraulic properties of the sandstone. Saturated hydraulic conductivity was statistically significantly decreased (15×–300×) as well as the capillary water absorption (2×–33× according to laboratory measurements, 5×–11× according to field measurements). Thanks to its hydrophobic properties, biologically-initiated rock crust can act as a factor notably decelerating the capillary water flow near the sandstone's surface and thus affects many processes. On the other hand, water-vapor diffusion was not significantly influenced by the biologically-initiated rock crust.