WATER INFILTRATION TO SANDSTONE OUTCROPS AT THE SOIL-ROCK INTERFACE

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Research motivation

- Water acts as a crucial agent in weathering of rock outcrops [1]
- Hydraulic properties and water regime in the rock, together with pore size distribution (PSD) of the rock are parameters affecting the effectivness of the weathering processes [1,2]
- PSD of rock is ordinarily obtained from mercury intrusion porosimetry that requieres destructive aproach
- Compared to a range of laboratory-based studies, distinctly fewer field studies have investigated the water presence and flow in the natural rock outcrops
- Current knowledge lacks substantiated data on the possible sources of the water in the outcrops

Research long-term goals

- To investigate potential sources of water for the rock outcrops, including soil cover
- To test the applicability of non-destructive approach for obtaining PSD of the rock, using non-Newtonian fluids
- To examine variability of hydraulic properties and PSD of natural rock surfaces

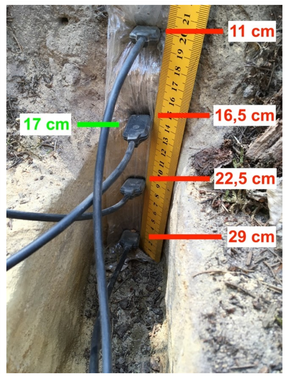
Methods used

- The research was conducted at natural outcrop of Cretaceous sandstone in Czechia
- In a vertical profile at the top of the outcrop, the development of water content both in topsoil and rock was measured over 40 days using Time Domain Reflectometry probes
- The development was compared with rainfall totals from nearby weather station
- Using Karsten tubes and single-ring infiltrometers, the infiltration rate into sandstone surfaces was measured

Infiltration rate measuring using Karsten tube

Infiltration rate measuring using single-ring infiltrometer

Profile of TDR probes to obtain water content development

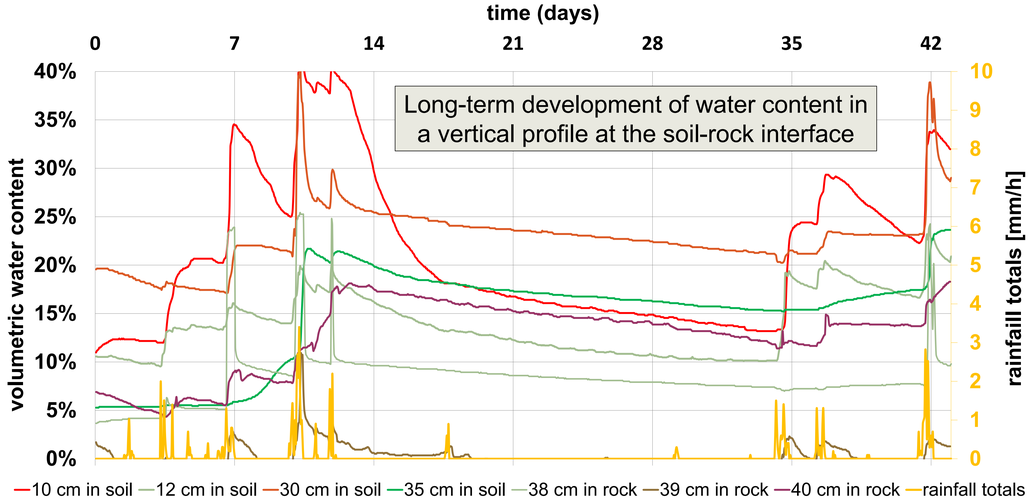


Preliminary results

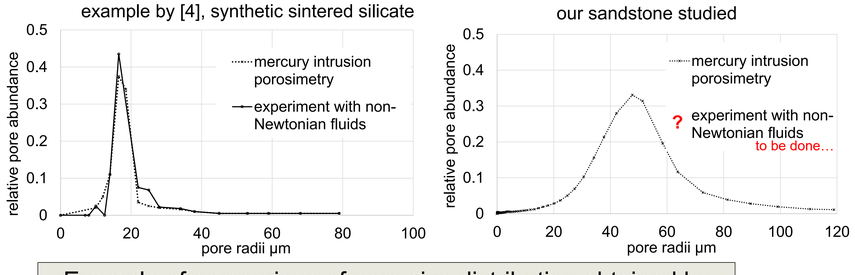
- The topsoil cover seems to be a considerable water reservoir enabling rock-infiltration of otherwise run-off rainwater
- Water infiltrated to the sandstone only when water content in the soil reached a certain threshold (roughly 17–27 vol. %), and at lower saturations the soil cover retained all the rainwater
- The infiltration rate (m/s) of the sandstone surfaces differed up to four orders of magnitude over a distance of tens of meters, depending on the weathering degree of the surface

To be done…

- To study the other possible sources of water, e.g., subsoil or water condensation from air
- To investigate the possibilites of obtaining *in situ* rock PSD via set of saturated flow experiments with non-Newtonian fluids analogously to [3, 4]
  - Requires performing *n* infiltration experiments with *n* concentrations of shear-thinning solutions
  - The experiments will be conducted in order to calibrate *n* representative pore radii along with their contribution to the saturated flow in the rock
  - The obtained PSD from the experiment will be compared to the result of standard mercury intrusion porosimetry similarly like in study by [4]



References:
[1] Ruedrich, J., Siegesmund, S. *Environmental Geology* 52, 225–249, 2007.
[2] Přikryl, R. *Quarterly Journal of Engineering Geology and Hydrogeology* 46, 4, 377–390, 2013.
[3] Abou Najm, M.R., Atallah, N.M. *Vadose Zone J.* 15,1–5, 2016.
[4] Rodríguez de Castro, A., Omari, A., Ahmadi-Sénichault, A., Bruenau, D. *Transp. Por. Med.* 101, 349–364, 2014



Example of comparison of pore size distribution obtained by two distinct methods