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Determination of the vaporization plane depth in porous materials: a new needle method

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In coarser porous materials (e.g. in natural sandstone bodies, buildings made of porous materials, or sandy soils), evaporation of pore water often occurs several mm to cm below the actual surface, at the so-called vaporization plane. The knowledge of the depth of this vaporization plane is critical for prediction of material disintegration, e.g. by salt or frost weathering. It also influences the presence of various organisms (mosses, lichens, fungi, etc.), and influences the evaporation rate, a critical process in the earth-atmosphere water balance. In the field, the vaporization plane depth can be determined by several proxy methods, the most common of which is the electrical resistivity tomography. Recently, a direct dye visualization method has been developed (Weiss et al., 2018). The methods currently being used have, however, either low spatial resolution, require special devices, or are too invasive. Here, we present the needle method (patent pending), a direct visualization field method that is simple-to-use, cost-effective and minimally invasive. The measuring device used is composed of a needle, glue and a dye in powder form, preferably uranine. This device is inserted into a hole previously drilled in the material of interest, left for some time so that the dye can react to the pore water, and later taken out and visually interpreted. The needle changes its appearance (especially colour) depending on the wetness of the material and we can, when following a suggested methodology, directly identify the vaporization plane depth with accuracy of several mm. The results using this method correspond to the dye visualization method, and in materials without substantial amount of salts in pore water also to the electrical resistivity method. We believe that this new method will find use in the scientific fields of geomorphology, heritage site protection, pedology, and porous material engineering.

References:
Weiss, T., Slavík, M., & Bruthans, J. (2018). Use of sodium fluorescein dye to visualize the vaporization plane within porous media. Journal of Hydrology, 565, 331-340.

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