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Evaporation from Layered Porous Media

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Evaporation rates from porous media may exhibit significant drop marking changes in hydraulic continuity and transport mechanisms and characteristic drying front depth defined by material pore size distribution. Evaporation behavior in layered media is expected to be affected by the extent and sequence of layering and capillary characteristics of each layer (wettability, pore size distribution). A simple model shows that the combination of intrinsic capillary characteristic length and position of a layer below evaporation surface define the ultimate depth of drying front at the end of capillary sustained stage 1 evaporation. The model was tested in laboratory experiments using Hele-Shaw cells filled with layers of coarse and fine sand (different combinations of thickness and position). We confirmed transition to stage 2 evaporation (diffusion controlled) occurring at a depth defined by exceeding of the weakest "capillary link" in the sequence. Additionally, drying front displacement may exhibit jumps in transition from fine to coarse layers due to air entry pressure mismatch. In addition to prediction of drying dynamics in layered porous media, our results provide new insights regarding fluid interface displacement processes in layered porous media