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# Dynamics of water evaporation from saline porous media with mixed wettability

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Understanding of the dynamics of salt transport and precipitation in porous media during evaporation is of crucial concern in various environmental and hydrological applications such as soil salinization, rock weathering, terrestrial ecosystem functioning, microbiological activities and biodiversity in vadose zone. Vegetation, plant growth and soil organisms can be severely limited in salt-affected land. This process is influenced by the complex interaction among atmospheric conditions, transport properties of porous media and properties of the evaporating solution (1-5). We investigated effects of mixed wettability conditions on salt precipitation during evaporation from saline porous media. To do so, we conducted a series of evaporation experiments with sand mixtures containing different fractions of hydrophobic grains saturated with NaCl solutions. The dynamics of salt precipitation at the surface of sand columns (mounted on digital balances to record the evaporation curves) as well as the displacement of the receding drying front (the interface between wet and partially wet zone) were recorded using an automatic imaging system at well-defined time intervals. The experiments were conducted with sand packs containing 0, 25, 40, 50, 65, and 80% fraction of hydrophobic grains. All experiments were conducted in an environmental chamber in which the relative humidity and ambient temperature were kept constant at 30% and 30 C, respectively. Our results show that partial wettability conditions had minor impacts on the evaporative mass losses from saline sand packs due to the presence of salt. This is significantly different than what is normally observed during evaporation from mixed wettability porous media saturated with pure water (6). In our experiments, increasing the fraction of hydrophobic grains did not result in any notable reduction of the evaporative mass losses from saline porous media. Our results show that the presence of hydrophobic grains on the surface leads to the formation of discrete efflorescence as opposed to the crusty efflorescence observed in the case of hydrophilic sand. Such a phenomenon contributes to further drying of partially wettable porous media as the diffusion resistance through the hydrophobic grains close to the surface is less than that of a salt crust formed at the surface of hydrophilic porous media. Our results highlight the importance of the preferential evaporation at the surface due to the presence of grains with different wettability which significantly influenced the general dynamics of the process in terms of the drying rate, precipitation patterns and the dynamics and morphology of the receding drying front delineated by analysing the recorded images.

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