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Pore Scale Study of Ion Transport in Porous Media with Mixed Wettability

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Soil salinization is a global soil degradation threat to crop production and water quality. Details of salt transport and deposition on land surfaces affect the earths energy balance and alters the hydrologic cycle. We study the evaporation-induced ion transport and deposition in mixed wettability porous media using rapid and high resolution synchrotron X-ray tomography. The porous medium was composed of two types of glass beads (differing in X-ray attenuation properties) packed into a cylindrical column (5 mm in diameter and 15 mm in height) enabling distinction between hydrophilic and hydrophobic grains. Different fractions of hydrophobic grains were saturated by CaI2 solution (5% in concentration) and exposed to evaporation under ambient conditions Resolved images facilitated detailed analyses of pore-scale wettability contrast effects on ion transport dynamics in drying porous media. Temporal and spatial evolution of ion concentration was quantified during evaporation and the convection diffusion equation was used to compute the dispersion coefficient. The results indicate how the ion dispersion coefficient is influenced by the wettability of the porous medium. Our results reveal the complex interplay between the mixed wettability condition, connectivity and geometry of capillary pathways, and preferential evaporation sites at the surface during evaporation which govern the dynamics of ion transport and preferential deposition in drying porous media.

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