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Effects of texture on salt precipitation dynamics and deposition patterns in drying porous media

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Understanding the physics of water evaporation from saline porous media is important in many natural and engineering applications such as durability of building materials and preservation of monuments, CO_2 sequestration and water quality. Also excess of salt accumulation in soil may result in soil salinization which is a global problem adversely affecting vegetation, plant growth and crop production. Thus it is important to understand the parameters affecting salt transport and precipitation in porous media. We applied X-ray micro-tomography to investigate the dynamics of salt precipitation during evaporation from porous media as influenced by the particle and pore sizes. The packed beds were saturated with NaCl solution of 3 Molal and the time-lapse X-ray imaging was continued for one day. The results show that the presence of preferential evaporation sites (associated with fine pores) on the surface of the sand columns influences significantly the patterns and dynamics of NaCl precipitation (Norouzi Rad et al., 2013; Norouzi Rad and Shokri, 2014). They confirm the formation of an increasingly thick and discrete salt crust with increasing grain size in the sand column due to the presence of fewer fine pores (preferential precipitation sites) at the surface compared to the sand packs with finer grains. Fewer fine pores on the surface also results in shorter stage-1 precipitation for the columns with larger grain sizes. A simple model for the evolution of salt crust thickness based on this principle shows a good agreement with our experiments. Our results provide new insights regarding the physics of salt precipitation and its complex dynamics in porous media during evaporation.

References

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