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Aquifer-on-a-Chip: Understanding pore-scale salt precipitation dynamics during CO₂ sequestration

Electronic Supplementary Information

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The Electronic Supplementary Information contains four videos (separate files) showing salt precipitation dynamics in (1) a straight channel with isolated pores, (2-4) in a microfluidic network at various magnifications. Three figures and associated discussions are ¹⁰ provided below showing (S1) a fluorscence image of salt precipitated from a droplet (S2) influence of CO₂ humidification on evaporation rate (S3) SEM images of salt formed from an NaCl solution, as compared to that formed from a similar solution with 100µm of fluorescein dye.



Fig. S1 Fluorescence microscope image of the dry-out of brine solution (35% NaCl) on glass slide after storing it at 85 °C on a hot plate for 7 days. The long aging period was employed to ensure all of the moisture was evaporated. The salt formations are well resolved through fluorescence imaging, as ³⁰ applied in the microfluidic chip.



Fig. S2 Influence of prior humidification on evaporation rate as determined by comparing results between a straight-channel entrance and an inlet channel structure with many isolated pores of evaporating brine. (a) Schematics of two different inlet strategies for dry CO_2 (*top*) and humidified CO_2 (*bottom*) into the red test section. (b) Evaporation rate observed over time for both cases. The evaporation rate is determined based on the interface movement with respect to time in both tests, hence the line with the steepest slope corresponds to the faster evaporation rate. Importantly, the amount of

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salt formed was consistent in both cases, specifically 24.5% (of pore volume) in the injection of dry CO_2 and 24.1% in the injection of partiallyhumidified CO_2 . These results indicate that while inlet chip geometry can influence evaporation rate, the final salt precipitation is relatively insensitive to this effect.



Fig. S3 Representative SEM images of (a) dried NaCl in DI water and (b) dried NaCl with fluorescein in DI water at different magnifications shown inset. ²⁰ In original solutions, NaCl was at a concentration of 4.7 mM, and fluorescein was at a concentration of 100 μ M. The SEM images show similar crystal structures and variation in both the pure NaCl solution, and that with fluorescein tracer, indicating that the tracer did not significantly alter the precipitation process or the structures formed.