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Experimental quantification of pore-scale flow of water and liquid CO2 in 2D heterogeneous porous micromodels at reservoir conditions[1]

YAOFA LI, FARZAN KAZEMIFAR , GIANLUCA BLOIS, KENNETH CHRISTENSEN, University of Notre Dame — Pore-scale flow interactions between water and supercritical CO_2 is relevant to large-scale geologic sequestration of CO_2. Recent studies have provided evidence of strong instabilities at the meniscus resulting in burst events and onset of inertial effects. This supports the notion that pore-scale physics cannot be captured by Darcian models and unsteady events play a defining role in CO_2 transport/trapping processes and such burst events may generate pressure fluctuations that can be linked to micro-seismic events in the pore structure. To this end, the pore-scale flow of water and liquid/supercritical CO_2 is investigated under reservoir-relevant conditions in 2D heterogeneous porous micro-models that reflect the complexity of a real sandstone. Fluorescent microscopy and micro-PIV are complemented by a fast differential pressure transmitter, allowing for simultaneous quantification of the flow field within and the instantaneous pressure drop across the micromodels. A number of CO_2 invasion patterns and corresponding pressure drop variations are observed over a range of wettability conditions, yielding a more comprehensive picture of the CO_2 drainage processes.

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