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Resolving the pore-scale dynamics of multiphase flow of supercritical CO2 and water in a 2D circular porous micromodel using high-speed microscopic PIV YAOFA LI, GIANLUCA BLOIS, KENNETH CHRISTENSEN, University of Notre Dame — Multiphase flow of supercritical CO_2 and water in porous media is relevant to geologic carbon sequestration and enhanced oil recovery, among many other applications in the energy and environmental sectors. After nearly two decades of research, it is now apparent that many macroscopic flow behaviors are controlled by pore-scale physics down to the micrometer scale. Recent evidence suggested that transient flow events such as Haines jumps, occurring on the time scale of milliseconds, and the associated dynamic effects, can greatly influence the accuracy of predictive models if not accounted for. Moreover, wetting properties of the porous matrix pose a strong control on the observed physics and dynamics, thus challenging its microscopic and macroscopic descriptions. To this end, the pore-scale flow of water and CO_2 is quantified using high-speed micro-PIV under reservoir-relevant conditions in a 2D circular micromodel featuring randomly distributed pillars and variable wettability. Resolving the flow is enabled by the very high temporal and spatial resolutions of the measurements. Statistical analysis during both steady and transient flows is performed to gain further insight into the intermittent behaviors as well as to quantify the effects of wettability on such behaviors.

Yaofa Li
University of Notre Dame

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