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Dissipative Processes during Two-Phase Flows

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A fundamental understanding of multiphase flows in porous media is relevant to enhanced oil recovery as well as to the process of CO2 sequestration in hydrocarbon reservoirs and saline aquifers. Recently, we quantified two-phase flow mechanisms in micromodels that represent the pore networks of natural complex porous media [1]. Using micro-Particle Image Velocimetry (micro-PIV), we are able to measure accurately the velocity distributions in porous media with a typical pore size of 5- 40µm. Moreover, we observe and quantify dissipative events, such as eddies within the aqueous phase [1]. These observations motivated further measurement of interfacial dynamics as well as pore-scale and thin film hydrodynamics [2] in a two-phase flow setting.
Following our initial work and [3], [4], [5], we explore the origins of dissipative processes at pore scale and their consequences on the upscaling of rock and fluid properties, i.e. relative permeabilities. For that purpose, we performed microfluidics experiments using porous media of varying complexity. Microfluidic experiments provide direct observations of dissipative events happening at pore scale. These experiments are associated with image processing techniques to track the fluid/fluid interface, to measure velocity distributions as well as thin film dynamics. We provide quantitative data on dissipative events, i.e. the trapped wetting phase showing a recirculating motion, for various flow conditions, with the aim to aid interpretation of core-scale relative permeability.

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