Experimental analysis of supercritical CO_2 migration at laboratory scale aimed to investigate capillary trapping

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Abstract. Fundamental trapping mechanisms that occur during carbon sequestration at deep geological conditions have been studied from different scientific perspectives throughout the last two decades. Fundamental capillary phenomena that determine the spatial distribution of non-wetting fluid migrating in saturated porous media need to be properly incorporated into numerical models in order to predict CO_2 plume evolution through the reservoir formation. The goal of our investigation is to develop experimental methods and obtain datasets that will be used for model validation as well as a benchmark for more complex experiments conducted under different heterogeneous packing configurations in a 16 ft long tank. This paper presents the results from a set of experiments that were conducted in an intermediate scale test tank. Conducting these types of experiments is highly challenging, as methods have to be developed to extrapolate the data from experiments that are conducted under ambient laboratory conditions to high temperatures and pressures settings in deep geologic formations. We explored the use of a combination of surrogate fluids that have similar density, viscosity contrasts and analogous solubility and interfacial tension as supercritical CO_2-brine in deep formations. The extrapolation approach involves the use of dimensionless numbers such as Capillary number (Ca) and the Bond number (Bo). The modeling analysis to verify whether existing models can capture the observed processes is carried out using TOUGH2/T2VOC codes developed by the Lawrence Berkeley National Laboratory. The results from the tank experiments and these model analyses are presented.

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