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# Modeling Core Flooding Experiments for $Co_2$ Geological Storage Applications

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**Abstract :** $CO_2$ geological storage is a proven technology for reducing anthropogenic carbon emissions, which is paramount for achieving the ambitious net zero emissions goal. Core flooding experiments are an important step in any $CO_2$ storage project, allowing us to gain information on the flow of $CO_2$ and brine in the porous rock extracted from the reservoir. This information is important for understanding basic mechanisms related to $CO_2$ geological storage as well as for reservoir modeling, which is an integral part of a field project. In this work, a different method for constructing accurate models of $CO_2$-brine core flooding will be presented. Results for synthetic cases and real experiments will be shown and compared with numerical models to exhibit their predictive capabilities. Furthermore, the various mechanisms which impact the $CO_2$ distribution and trapping in the rock samples will be discussed, and examples from models and experiments will be provided. The new method entails solving an inverse problem to obtain a three-dimensional permeability distribution which, along with the relative permeability and capillary pressure functions, constitutes a model of the flow experiments. The model is more accurate when data from a number of experiments are combined to solve the inverse problem. This model can then be used to test various other injection flow rates and fluid fractions which have not been tested in experiments. The models can also be used to bridge the gap between small-scale capillary heterogeneity effects (sub-core and core scale) and large-scale (reservoir scale) effects, known as the upscaling problem.

**Keywords :** $CO_2$ geological storage, residual trapping, capillary heterogeneity, core flooding, $CO_2$-brine flow
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