Predicting long-term fate of a CO_2-plume using vertical equilibrium models.

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Abstract: Models based on vertical equilibrium (VE) have been popular in the petroleum industry to compute recovery, sweep efficiency and other dynamic properties, see [**5**] and references therein. Whenever applicable (typically at large aspects ratios with good vertical communication) these models give a simple way to compute flow and transport in reduced spatial dimensions. In the past years VE-models have gained wide interest as an efficient way to predict long term fate of CO_2 sequestered into deep saline aquifers. In particular the VE-models can be used to compute CO_2-inventory, migration distances of the CO_2-plume, and can also be used in simulating leakage scenarios, see for example [**1, 2, 3, 4, 6, 7, 8, 9**]. However, these references all consider VE models with the additional simplification of sharp interfaces, which is equivalent to neglecting the effect of capillary forces and dissolution. In this paper we revisit the derivation of VE models. We then show how capillary effects and dissolution in the presence of hysteresis can be incorporated in VE-models, and demonstrate that these additional physical processes strongly affect predictions of CO_2 migration speed, distance and trapping.

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