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Gravity-Induced Ripening Undermines Capillary Trapping Stability KE XU, Massachusetts Institute of Technology, YASHAR MEHMANI, Stanford University, LUORAN SHANG, Fudan University, QINGRONG XIONG, University of Manchester — Capillary (residual) trapping has long been considered as one of the safest CO2 sequestration mechanisms due of its hydrodynamic stability. Here we show, for the first time, that the long-term thermodynamic stability of capillary trapping could be compromised because of gravity, which has thus far been neglected in studies of bubble ripening. The interaction of gravity with molecular diffusion causes the vertical redistribution of trapped bubbles in a geologic porous medium, where bubbles at the top grow at the expense of bubbles at the bottom. The result is the formation of a gas cap at the top of the reservoir posing subsequent leakage risks. Accurate predictions of CO2 storage stability must therefore account for gravity-induced ripening. Here, we analyze the evolution of a population of trapped bubbles over time and develop simplified pore-scale and continuum models capturing its salient physics. The models reveal that the upward migration of CO2 may be hindered through the judicious selection of CO2 storage sites.

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