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Density driven convection with dissolution in porous media: experiment, simulation and linear stability analysis XUHUI MENG, Huazhong University of Science and Technology, XIAOFAN YANG, Pacific Northwest National Laboratory, ZHAOLI GUO, Huazhong University of Science and Technology
— Geological storage of the CO2 in subsurface saline aquifers is a promising way to reduce CO2 emissions. During this process, CO2 first dissolves into pure brine. Then the acidic and denser mixture falls down under the gravity and reacts with the rock. In the present work, a microfluidic experiment is conducted to investigate the density-driven convection with dissolution in porous media. Moreover, the linear stability analysis and numerical simulations are further performed to investigate the interfacial instability. The results demonstrate that front instability can be triggered by the density contrast between the two miscible fluids, leading to the Rayleigh-Taylor instability. While this type of instability can be suppressed by the surface reaction between the fluid and solid phases, which prevents the transport of the denser fluid to the deeper region at the beginning. Over the long term, it is found that the interfacial instability can be influenced by the evolution of the porosity due to the dissolution, which will drive the transport of denser fluid further down. Our investigation shows that the transport of the reactive fluid in porous media depends on the competition among the density contrast, the chemical reaction rate and the evolution of the porosity/permeability.

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