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Effect of Permeability Anisotropy on Morphological Evolution a Chemical Dissolution Front in a Fluid-Saturated Porous Medium

Keng-Hsin Lai (1) and Jui-Sheng Chen (2)

(1) National Central University, Graduate Institute of Applied Geology, Taoyuan County, Province Of China Taiwan (qqegg99@yahoo.com.tw, 886-3-4263127), (2) National Central University, Graduate Institute of Applied Geology, Taoyuan County, Province Of China Taiwan (jschen@geo.ncu.edu.tw, 886-3-4263127)

The dissolution-induced finger pattern in geological medium plays an important role in a variety of geological processes and engineering practices. Previously studies have extensively developed the numerical model to investigate the development of the chemical dissolution front within a fluid-saturated porous medium. These numerical models considered the geological media permeability to be isotropic, whereas geological medium typically presents anisotropy in permeability. This study attempts to investigate the effect of permeability anisotropy on the morphological evolution of the chemical dissolution front. A series of numerical simulations are performed to explore how the permeability anisotropy affects the morphological evolution of reaction front. Results show that the permeability anisotropy has significant impacts on the evolution of dissolution reaction front. For medium with permeability anisotropy ratio smaller than unity, the length of the reaction front is larger than that for isotropic medium. This is due to that the flow-focusing mechanism is enhanced by larger lateral flow capturing for permeability anisotropy ratio smaller than unity. The difference between reaction fronts of the two medium diminishes when the upstream pressure gradient is large. For medium with permeability anisotropy ratio greater than unity, the anisotropy model predicts a shorter front length than isotropic model does. The effect of the permeability on reaction front decreases with decreasing upstream pressure gradient. Moreover, permeability anisotropy does not significantly modify the primary and secondary upstream pressure gradient.