Convection-diffusion-reaction of CO2-enriched brine in porous media: A pore-scale study

GCCC Publication Series #2019-20

H. Dashtian
S. Bakhshian
S. Hajirezaie
J-P. Nicot
S.A. Hosseini

Keywords: fluid characterization, storage, fluid flow model

Cited as:
Dashtian, Hassan, Sahar Bakhshian, Sassan Hajirezaie, Jean-Phillipe Nicot, and Seyyed A. Hosseini, 2019, Convection-diffusion-reaction of CO2-enriched brine in porous media: A pore-scale study, GCCC Publication Series #2019-20, originally published in *Computers & Geosciences,* 125, 19-29.

Abstract

CO_2-enriched brine interaction with reservoir minerals and the subsequent mineral trapping of CO_2 alter the morphology of pore structure. Such changes in the pore space modify the storage capacity of reservoirs and increase the long-term security of CO_2 storage. The extent of pore space modification depends on the relative weight of advection, diffusion and reaction mechanisms. We present a general framework for a direct simulation of reactive transport in digitized reservoir rock samples based on a pore-scale modeling in two-dimensional (2D) and three-dimensional (3D) pore-throat networks. We examine the impact of transport properties such as Péclet (Pe) and Damköhler (Da) numbers, on the petrophysical properties and dissolution of mineral in pore space. We implement marker-based watershed segmentation to extract pore networks of 3D micro-CT (Computerized Tomography) scan images. The extracted network is used to simulate the reactive solute transport and dissolution on real rock samples. This approach enables us to study reaction of CO_2-enriched brine with reservoir rock samples, which is vital in predicting long-term security of CO_2 storage. We implement our approach to study CO_2 injection in samples from the Cranfield site, Mississippi, U.S.A. We show that for small PeDa numbers, the concentration and dissolution patterns are more uniform.