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Elastic properties evolution of carbonate rocks during reaction induced by carbon dioxide injection

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The sequestration of carbon dioxide in deep underground reservoirs is proposed as a strategy to alleviate atmospheric greenhouse gas emissions. Upon introduction into the host brine, carbon dioxide dissolves, creating an acidic solution. This acidity can subsequently engage with the host rock, prompting dissolution, particularly in carbonate formations. The mechanical change of host rock brought by this dissolution could be evaluated by the change of elastic properties(bulk and shear modulus). We performed pore scale simulations to examine the alterations in the micro-structure of rocks induced by the injection of CO_2-saturated brine, focusing on understanding the consequential evolution of the elastic properties of carbonate rocks. We modeled the evolution of the pore structure during dissolution by Volume of Solid method(VoS method), a finite volume method, and then calculated the changes in elastic properties by finite element method, combining with the effective medium theory. During our simulation, estaillades carbonate core is injected with CO_2-saturated brine at 50 ℃ and 10 MPa. After determining the accuracy of the simulation by comparing the reaction rate with that of the experiment under the same conditions, the changes in elastic properties was calculated. The efficiency of the VoS method lies in its computational simplicity, eliminating the need for remeshing or any specialized handling of topological changes.

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