Permeability evolution in fractured carbonates exposed to reactive flow

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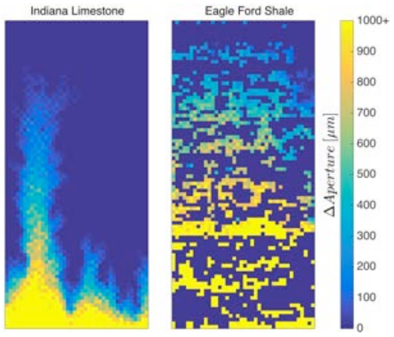
For fractures in carbonate rocks, permeability can increase significantly when reactive flows cause mineral dissolution. Calcite is soluble, fast-reacting, and often sufficiently abundant that its dissolution leads to substantial changes in void volume. We investigated reaction-induced permeability changes in fractured limestones exposed to high-pressure CO_2-saturated brines. For experiments with a fractured core of Indiana Limestone, which is pure calcite, positive feedback produced channelization, causing higher than expected permeability [1]. For a fractured core of Amherstburg Limestone, which includes less reactive minerals, complex reaction patterns emerged [2]. Modeling studies accounted for 2D reactive transport [3] coupled with elastic deformation [4]. For the Indiana Limestone simulation, the permeability is initially limited by unreacted downstream apertures until a channel emerges and permeability increases rapidly. For simulations of the Eagle Ford shale, which contains bedding layers of nonreactive minerals, initially the unbuffered acid quickly flows downstream, but the absence of channels produces no drastic increase in permeability. This study demonstrates that mineral heterogeneity and spatial patterns of minerals are key to prediction of reaction-induced permeability evolution.



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