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Mixed-dimensional models for simulation of reactive transport in fractured porous media

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Numerical simulations of reactive transport in fractured porous media are necessary for several environmental and engineering applications. Networks of fractures may behave as shortcuts for the transport processes, whereas chemical reactions trigger mineral dissolution and precipitation that alter the porous medium and fracture walls locally. This will either cement flow paths or open new ones, impacting the global flow regime.
In this talk, we present an approach to simulate reactive transport in fractured porous media, where dissolving and precipitating minerals might alter the flow characteristics. Our numerical solution strategy is based on a discrete fracture-matrix model with a mixed-dimensional representation of the fractured media. The model equations consist of coupled partial differential equations for the fluid flow, heat transfer and solute transport and non-linear algebraic equations representing the chemical reactions. The mineral dissolution and precipitation are formulated as a complementarity problem. The partial differential equations are discretized using finite-volume methods, and the resulting non-linear system of differential-algebraic equations is solved by Newton's method.
Numerical tests illustrate our model's ability to capture the tightly coupled physical and chemical processes and the two-way interaction with the fractures. Moreover, we discuss application of our framework to simulations representative of, e.g., geothermal field cases, where stability and computational cost become major concerns.

Participation

In-Person

References

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