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Dissolution Patterns and Dispersion in Fractures

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Dissolution is very important for rock deformation. Reaction-infiltration instability refers to the morphological instability of a reactive fluid front flowing in a soluble porous medium. The medium is chemically dissolved in the fluid at an overall rate depending on the local permeability and the rate of reaction. Locally, an increase in permeability augments the flow and thus the rate of dissolution. In that way a positive feedback loop is established between dissolution and permeability increase. This process is important for many natural phenomena, such as the weathering and digenesis of earth rock, dissolution of salt deposits and melt extraction from the mantle etc. The presentation is focused on the experiments in which the injection of reactive fluids in the cell allows for dissolution of the medium and the fluorescein acts as tracer to observe the flow.

Injection of a reactive fluid into an open fracture may modify the fracture surface locally and create a ramified structure around the injection point. This structure will have a significant impact on the dispersion of the injected fluid due to an increased permeability which will introduce large velocity fluctuations in the fluid. We have injected a fluorescent fluid into such a ramified dissolution structure. The transparency of the Hele-Shaw cell makes it possible to follow the detailed dispersion of the fluorescein concentration. The experiments have been compared to two dimensional (2D) computer simulations which include both convective motion and molecular diffusion.