Geophysical Research Abstracts
Vol. 18, EGU2016-356, 2016
EGU General Assembly 2016


# Invariantly propagating dissolution fingers in finite-width systems

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Dissolution fingers are formed in porous medium due to positive feedback between transport of reactant and chemical reactions [1-4]. We investigate two-dimensional semi-infinite systems, with constant width $W$ in one direction. In numerical simulations we solve the Darcy flow problem combined with advection-dispersion-reaction equation for the solute transport to track the evolving shapes of the fingers and concentration of reactant in the system.

We find the stationary, invariantly propagating finger shapes for different widths of the system, flow and reaction rates. Shape of the reaction front, turns out to be controlled by two dimensionless numbers – the (width-based) Péclet number $Pe_W = vW/D\phi_0$ and Damköhler number $Da_W = ksW/v$, where $k$ is the reaction rate, $s$ – specific reactive surface area, $v$ - characteristic flow rate, $D$ – diffusion coefficient of the solute, and $\phi_0$ – initial porosity of the rock matrix.

Depending on $Pe_W$ and $Da_W$ stationary shapes can be divided into seperate classes, e.g. parabolic-like and needle-like structures, which can be inferred from theoretical predictions. In addition we determine velocity of propagating fingers in time and concentration of reagent in the system. Our simulations are compared with natural forms (solution pipes).

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