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Network models of dissolution and precipitation of porous media

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Chemical erosion of a porous medium is a complex process, involving the interplay between flow, transport, reaction and geometry evolution. The nonlinear couplings between these processes may lead to the formation of intricate dissolution patterns, the characteristics of which depend strongly on the fluid flow and mineral dissolution rates. In particular, in a broad range of physical conditions, long, finger-like channels or "wormholes" are spontaneously formed, where the majority of the flow is focused. To study this process, we model the porous medium as a system of interconnected pipes with the diameter of each segment increasing in proportion to the local reactant consumption. Moreover, the topology of the network is allowed to change dynamically during the simulation: as the diameters of the eroding pores become comparable with the interpore distances, the pores are joined together thus changing the interconnections within the network. With this model, we investigate different growth regimes in an evolving porous medium, allowing for both erosion and precipitation of the dissolved material.