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A network model of channel competition in fracture dissolution[1]

TONY LADD, University of Florida, PIOTR SZYMCZAK, Warsaw University —

During dissolution in porous or fractured rock, a positive feedback between fluid transport and chemical reactions at the mineral surfaces may lead to the formation of pronounced, wormhole-like channels. As the dissolution proceeds the channels interact, competing for the available flow, and eventually the growth of the shorter ones ceases. Thus the number of channels decreases with time while the characteristic distance between them increases, which leads to a scale-invariant, power-law distribution of channel lengths. A simple resistor network model of the evolution of dissolving channels is constructed and its properties studied. The results are compared with pore-scale simulations of fracture dissolution using a microscopic, three-dimensional numerical model. Despite its simplicity, the resistor model is found to retain the essential features of the nonlinear interaction between the channels.

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Tony Ladd
University of Florida

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