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On the relationship between connectivity and reaction rates

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The presence of connected hydrogeologic structures associated with extreme values of permeability have been recognized as the most singular feature of an aquifer controlling the fate and transport of contaminants. The presence of such features typically induces preferential channels that concentrate flow and produce extreme large/small values of travel times. Albeit the potential risk associated with polluted groundwater systems depends on how toxic contaminants displace and react through a heterogeneous porous media, the interaction between connectivity, mixing and chemical reactions has not been yet addressed. In this work, we study the relationship between reaction rates and flow and transport connectivity through extensive numerical simulations of a reactive chemical system moving through a randomly heterogeneous porous media. A variety of random function models are used, ranging from the standard multiGaussian model, in which extreme values of permeability are weakly correlated, to more sophisticated stochastic simulation of random fields in which highly connected structures associated with large and low values of permeability are mandated.