Role of porescale flow heterogeneity and mass transfer processes in transport in composite porous media

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We consider pore scale transport in a composite medium consisting of two components of similar porosity and different hydraulic conductivity. It has been observed (Berkowitz et al., 2009, Water Resour. Res.) that breakthrough curves measured at each end of the medium behave differently while the Darcy-scale advection-dispersion equation predicts otherwise. Motivated by these observations we study the flow and transport properties in such media using pore scale simulations considering different regular and random packings of grains, and size distributions. We explore different velocity distributions generated by the pore structures and specifically the role of low velocity or stagnant zones. We analyze the impact of the velocity field properties on solute transport to establish a relation between the grain distribution and porosity, the velocity PDF and the breakthrough behavior.