Upscaling matrix diffusion coefficients for heterogeneous fractured rocks

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Abstract: The scale dependence of the matrix diffusion coefficient ($D_m$) for fractured media has been observed from variable-scale column experiments to field tracer tests. In this paper, we derive the effective $D_m$ for multimodal heterogeneous fractured rocks using characteristic distributions of matrix properties and volume averaging of the mass transfer coefficient (Dai et al., 2007). The effective field-scale $D_m$ is dependent on the statistics (geometric mean, variance, and integral scale) of laboratory-scale ln($D_m$) and on the domain size. The effective $D_m$ increases with the integral scales and is larger than the geometric mean of ln($D_m$). Monte Carlo simulations with 1000 realizations of heterogeneous $D_m$ fields were conducted to assess the accuracy of the derived effective $D_m$.

Reference: