Geophysical Research Abstracts
Vol. 13, EGU2011-1571, 2011
EGU General Assembly 2011

Lack of relevance of diffusion to dispersion and subordinate role of multi-scale heterogentiy

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The inference from application of stochastic subsurface hydrology to conservative solute transport that the nearly linear increase in dispersivity with increasing length scale is related to multi-scale heterogeneity is demonstrably false. The first time an accurate calculation of the dispersivity due to advection is performed for a single scale of heterogeneity, a monomodal distribution of local conductances (neglecting effects of diffusion altogether) yields already the observed linear dependence of dispersivity on spatial scale over 10 orders of magnitude of length scales. This is shown by comparison with nearly 2200 experiments. Further, for two dimensional flow fields it yields the observed tailing of the solute arrival time distribution in fracture flow experiments that is usually attributed to diffusive exchange with the rock matrix.

It would appear that a rethinking of the fundamental tenets of subsurface hydrology is in order.