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Scale-dependent hydraulic conductivity

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Scale-dependences are well-known consequences of non-linear physics. The hydraulic conductivity, K, though sometimes a non-linear function, is a linear property by definition. Thus it has been difficult for me to accept claims that K could be generally scale-dependent. In attempting to resolve this I have found several reasons why a scale-dependent K could be observed: 1) The medium is a pipe, producing an obvious proportionality to the square of the linear dimension of the system. 2) In general, neither the mean, nor the geometric mean, of K values at one scale has any relationship with the K value at a larger scale. Thus an increase in <K> with scale does not imply easier conduction at larger scales. 3) Statistical bias, i.e., systematic sampling exclusion of the most conductive regions of the system at small scales (if they belong to fractures larger than the system size). 4) Experimental shapes. Long narrow volumes act as 1-D systems, but increases in all dimensions will cause a cross-over to 3-D conduction. This kind of behavior is likely quite common in anisotropic systems, but is accompanied by a diminution of K with increasing size in the perpendicular direction(s).