Geophysical Research Abstracts, Vol. 9, 11148, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-11148

Persistence of anomalous dispersion in uniform porous media demonstrated by pore-scale simulations

Xiaoxian Zhang

SIMBIOS Centre, University of Abertay Dundee , Bell Street, DD1 1HG, Dundee DD1 1HG

The anomalous dispersion observed in solute transport through porous media is often attributed to media heterogeneity at various scales, whilst chemical movement in homogenous media is traditionally thought to be Fickian. However, increased evidence over the past few years has shown that even in carefully packed homogenous media, solute movement may not be Fickian as previously thought. Based on pore-scale simulations, we demonstrate that in a simple uniform porous medium where all pores are well hydraulically connected, the movement of passive tracers appears to be anomalous. It is found that the macroscopic dispersion coefficient increases with time first in a power law prior to reaching an asymptotic value, but the spatial distribution of the plume remains non-Gaussian and cannot be described adequately by the advection-dispersion equation. In particular, the spatial distribution of the plume has a persistent tail that does not decay with the distance from the peak in $c \propto \exp(-bx^2)$ as predicted by the advection-dispersion equation, but in $c \propto \exp(-a|x|)$ with a depending on the Peclet number. The concentration in the plume front, on the other hand, decays faster than predicted by the advection-dispersion equation. Comparing the results to the continuous time random walk (CTRW) reveals that the solute movement is well described by CTRW with a modified exponentially distributed transition time. The plume shows a transition from anomalous to normal transport, but at a slow rate. Given the time it takes for such a transition to complete in such a uniform media, it is anticipated that in natural media where multiple-scale heterogeneity exists, a transition from anomalous to normal transport may never complete.