Geophysical Research Abstracts, Vol. 9, 09951, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-09951


# Laboratory experiment of solute transport in a fracture with one porous wall

L. Michel, J.-P. Caudal, J. de Bremond d'Ars, Y. Méheust

Géosciences Rennes, UMR CNRS 6118, Université de Rennes 1, 35042 Rennes Cedex, France

Contaminant transport in heterogeneous fractured aquifers occurs mostly through the networks of intersecting fractures. The characterization and modeling of transport through these systems must take heterogeneity into account, both at the scale of the fracture network and at the scale of the fracture itself. The physical mechanisms of solute transport in a single fracture with impermeable walls are well identified: advection, Taylor-Aris dispersion, roughness dispersion, aperture-variation dispersion and molecular diffusion.

We address here solute transport through a fracture with a porous wall. To our knowledge, there is no fundamental description of the mass transfert coefficient between the region of high permeability (the fracture) and that of low permeability (the surrounding matrix). We present an analog experimental model setup in which we can focus on specific dispersion mechanisms, neglecting molecular diffusion, in order to extract descriptive laws that will be integrated in future numerical models. The planar horizontal fracture is 1 m long, 5 cm wide and its mean aperture is 5 mm. It is bounded by either two smooth parallel Plexiglass plates (impermeable walls configuration), or by one such plate and a porous medium consisting of 1 mm glass beads ("semi-permeable" configuration). A permanent laminar water flow is forced through the fracture at controlled mean velocity ($\sim$ 1mm/s), and a dye (patent blue) injection system simulates a point source of contaminant along the center plane of the fracture. The tracer plume is tracked using a visualization system based on lasers illuminating a series of vertical linear optical sensor arrays. It yields a quantitative temporal description of the tracer concentration, integrated over the fracture width and at several positions along the fracture length.

We have first validated the setup using the impermeable walls configuration. The total amount of dye passing in front of each laser was monitored, and compared to classical advection-dispersion models (for different injection modes). Conservation of the total dye quantity was checked. Gravity effects are generally disregarded in theoretical studies; they were observed to be significant. In a second stage, we have started addressing the impermeable-porous configuration. Preliminary results on mass transfer between the fracture and the bounding porous matrix are presented.