Geophysical Research Abstracts
Vol. 17, EGU2015-11974, 2015
EGU General Assembly 2015

Identification of transport processes in Southern Indian fractured crystalline rock using forced-gradient tracer experiments

Nicolas Guihéneuf (1,2), Olivier Bour (2), Alexandre Boisson (1), Tanguy Le Borgne (2), Matthew R. Becker (3), Benoit Nigon (1), Mohammed Wajiduddin (4), Shakeel Ahmed (5), and Jean-Christophe Maréchal (6)

(1) BRGM, D3E, NRE, Indo-French Center for Groundwater Research, Uppal Road, 500007 Hyderabad, India, (2) Géosciences Rennes, UMR6118 CNRS – Université de Rennes 1, 35042 Rennes Cedex, France, (3) Department of Geological Sciences, California State University Long Beach, Long Beach, California, 90840, United States, (4) Indo-French Center for Groundwater Research, Uppal Road, 500007 Hyderabad, India, (5) National Geophysical Research Institute, Indo-French Center for Groundwater Research, Uppal Road, 500007 Hyderabad, India, (6) BRGM, D3E, NRE, 1039, rue de Pinville, 34000 Montpellier, France

Understanding dominant transport processes is essential to improve prediction of contaminants transfer in fractured crystalline rocks. In such fractured media, solute transport is characterized by fast advection within open and connected fractures and sometimes by matrix diffusion that may be enhanced by chemical weathering. To investigate this phenomenon, we carried out radially convergent and push-pull tracer experiments in the fractured granite of the Experimental Hydrogeological Park of Choutuppal (Southern India). Tracer tests were performed in the same permeable fracture from few meters to several ten meters and from few hours to two weeks to check the consistency of the results at different spatial and temporal scales. These different types of forced gradient tracer experiments allow separation of the effects of advection and diffusion on transport.
Breakthrough curves from radially convergent tracer tests display systematically a -2 power law slope on the late time behavior. This tailing can be adequately represented by a transport model that only takes into account heterogeneous advection caused by fluid flow channeling. The negligible impact of matrix diffusion was confirmed by the push-pull tracer tests, at least for the duration of experiments. A push-pull experiment carried out with a cocktail of two conservative tracers having different diffusion coefficients displayed similar breakthrough curves. Increasing the resting phase during the experiments did not lead to a significant decline of peak concentration. All these results suggest a negligible impact of matrix diffusion. However, increasing the scales of investigation during push-pull tracer tests led to a decrease of the power law slope on the late time behavior. This behavior that cannot be modeled with a transport model based on independent flow paths and indicate non-reversible heterogeneous advection. This process could be explained by the convergence of streamlines after a certain distance from the borehole that leads to mass exchange between flow paths and thus increase dispersion of tracer.