Bill X. HU, 2013. Quantitative Study of Groundwater Flow and Solute Transport in Karst Aquifers. *Acta Geologica Sinica* (English Edition), 87(supp.): 636.

Quantitative Study of Groundwater Flow and Solute Transport in Karst Aquifers

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Karst aquifers are valuable and essential resources and are extremely susceptible to contamination due to rapid transport processes and limited chemical filtering capacity that normally slows the spread of solutes in nonkarstic aquifers. Quantitative understanding of karst hydrologic functions is integral to managing water resources and developing protection or remediation strategies. In the last several years, Dr. Hu and his group developed novel mathematical, numerical and physical models to simulate groundwater flow and solute transport in karst aquifers having conduits imbedded in a porous medium, such as limestone. A dual-porosity model is developed to simulate the flow and transport in the karst aquifers, in which the Stokes equations are used to model the flow in the conduits and the Darcy equation is used for the flow in the matrix. The Beavers-Joseph interface boundary conditions are adopted to describe the flow exchange at the interface boundary between the two domains. The developed mathematical/numerical models well match laboratory experimental results. In a simulation of a regional groundwater flow and solute transport processes, the developed models significantly improve simulation results than traditional groundwater models. The developed modeling method advances our simulation capacity for groundwater flow and solute transport in karst aquifers.

Key works: karst aquifer, dual porosity, modeling, Stokes equation, experiments.

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