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Diffusion, Coulombic interactions and multicomponent ionic transport of charged species in saturated porous media

Massimo Rolle¹, Muhammad Muniruzzaman²

¹ Technical University of Denmark, Denmark

² University of Tuebingen, Germany

Corresponding Author E-mail: masro@env.dtu.dk

Abstract: Diffusion and compound-specific mixing significantly affect conservative and reactive transport in groundwater at different scales, not only under diffusion-dominated regimes but also under advection-dominated flow through conditions. When dissolved species are charged, besides the magnitude of their aqueous diffusion coefficients also the electrostatic interactions significantly affect solute displacement. We investigated electrostatic interactions between ionic species under flow-through conditions resulting in multicomponent ionic dispersion: the dispersive fluxes of the different ions in the pore water are cross-coupled due to the effects of Coulombic interactions. Such effects are illustrated

in flow-through experiments in saturated porous media. Simple strong electrolytes (i.e., salts and strong acid solutions) were selected as tracers and their transport was studied under different advection-dominated conditions in homogeneous and heterogeneous porous media. The model-based interpretation of the experimental results is challenging since it requires a multicomponent ionic formulation with an accurate description of local hydrodynamic dispersion and explicitly accounting for the cross-coupling of dispersive fluxes due to the Coulombic interactions between the ions in the pore water.



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南方科技大学 环境科学与工程学院
地址：深圳市南山区学苑大道 1088 号

SUSTech|School of Environment
Address: No 1088,xueyuan Rd., Xili, Nanshan District,
Shenzhen, Guangdong, China

邮编：518055
电话：0755-88010821
传真：0755-88010822
网址：<http://www.sustc.edu.cn/ese>

Postcode: 518055
Tel: 0755-88010821
Fax: 0755-88010822
Web: <http://www.sustc.edu.cn/ese>