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Graphene Oxide-Facilitated Uranium Transport and Release in Heterogenous Saturated Medium

Jianying Shang (1), Kang Zhao (1), Chong Chen (1), and Tao Cheng (2)

(1) China Agricultural University, Water and Soil Sciences, China (jyshang@cau.edu.cn), (2) Department of Earth Sciences, Memorial University St. John's, Newfoundland and Labrador, A1B 3X5, Canada

Natural subsurface environment is a complex heterogeneous system. To investigate the effect of ionic strength (IS) and heterogeneity on the transport and remobilization of graphene oxide (GO)-facilitated uranium (U) in saturated porous media, column experiments were performed by the injection of U alone and U+GO mixtures into homogeneous and heterogeneous porous media under low and high ionic strength (1 and 50 mM) conditions, and then the columns were successively flushed with background solution and DI water. Results showed that when U only was introduced into the columns, IS had little effect on the migration of uranium alone in both media and the presence of preferential flow in heterogeneous media slightly enhanced the mobility of U. For the U+GO treatment, GO showed strong mobility under low IS solution and high released peak under high IS. The appearance of GO significantly enhanced uranium transport in both media. Under low IS solution, the mobility of uranium was significantly enhanced at the injection phase, and the medium heterogeneity further promoted the amount of GO-sorbed uranium transport. Under high IS solution, less GO-sorbed uranium was observed during injection phase, and a large amount of retained GO-sorbed uranium was released with GO remobilization during water flushing phase, and the release showed the longer-tailing phenomenon and the release amount was more pronounced in heterogeneous media. The findings in this study showed that solution chemistry and media heterogeneity played important roles in GO-facilitated U transport and release in soil and groundwater system.
Keywords: Uranium; Transport; Graphene oxide; Heterogeneity; Ionic strength