Geophysical Research Abstracts
Vol. 21, EGU2019-8670, 2019
EGU General Assembly 2019

Measurement and estimation of NAPL-Water interfacial areas for four porous media using kinetic interface sensitive tracers

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Fluid-fluid interfacial area (IFA) in a two-phase flow in porous media system plays an important role in understanding the mass- and energy-transfer processes between the fluid-phases. New theories of multiphase flow in porous media suggest including the fluid-fluid interfacial area (e.g. Joekar-Niasar and Hassanizadeh 2012). Most recently a new category of reactive tracers has been proposed by Schaffer et al. 2013), termed kinetically interface sensitive which are able to quantify the size of the fluid-fluid IFA. Previous experiments Tatomir et al. (2018) have demonstrated the application of the KIS tracers in a highly-controlled column experiment filled with a well-characterized porous medium consisting of an ideal well-sorted and highly spherical glass beads (and having uniformity coefficient of 1.2).
The aim of this work is to expand the applicability of the tracer to other porous media systems. The first category is represented by porous media composed of glass beads, while the second category by porous media composed of natural quartz sand. In both categories two mean diameters are tested, a medium sand with the mean diameter $d_{50} = 150\mu$m and a coarse sand $d_{50} = 240\mu$m. All four porous media have different diameter ranges, with different distributions and different uniformity coefficients. Also we investigate the assumption of Joekar-Niasar and Hassanizadeh (2012) that the uniqueness of the capillary pressure-saturation-specific IFA surfaces are likely to be more unique for angular soils, due to contributions from the main terminal interfaces and corner interfaces to the total IFA.
By applying KIS tracer method we provide a quantitative characterization of the impact of porous medium texture and grain surface texture and size on the NAPL/water IFA. Literature has shown from experimental and geometric models that the magnitude of maximum IFA is inversely proportional to the grainsize of the porous media increasing linearly with decreasing grain diameters. The results obtained by the KIS tracer method for the four porous media reveal the same behavior. Moreover, obtained IFA values are consistent with literature data obtained with other techniques. The results show that KIS method can be added to the available laboratory methods to determining the fluid-fluid IFA, e.g. interface partitioning tracer tests, high-resolution microtomography. Future comparison studies with the other methods will bring more clarity with respect to which IFA these techniques measure (e.g., moving interface, film-associated interface, stagnant region).

Joekar-Niasar V, Hassanizadeh SM (2012) Uniqueness of Specific Interfacial Area–Capillary Pressure–Saturation Relationship Under Non-Equilibrium Conditions in Two-Phase Porous Media Flow. Transp Porous Med 94:465–486. doi: 10.1007/s11242-012-9958-3

Schaffer M, Maier F, Licha T, Sauter M (2013) A new generation of tracers for the characterization of interfacial areas during supercritical carbon dioxide injections into deep saline aquifers: Kinetic interface-sensitive tracers (KIS tracer). International Journal of Greenhouse Gas Control 14:200–208. doi: 10.1016/j.ijggc.2013.01.020

Tatomir A, Vriendt KD, Zhou D, et al (2018) Kinetic Interface Sensitive Tracers – Experimental Validation in a Two-Phase Flow Column Experiment. A Proof of Concept. Water Resources Research: doi: 10.1029/2018WR022621