Geophysical Research Abstracts
Vol. 20, EGU2018-16076, 2018
EGU General Assembly 2018

Effects of porous media heterogeneity on the flow distribution of shear-thinning fluids

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The complexity of flow topology in natural environments, chemical transport and resulting reactivity, arises from the random spatial organization of the host medium, the interaction at the fluid-solid interfaces and the rheological fluid properties. The latter, beside triggering hydrodynamic instabilities important in many situations, like $CO_@$ sequestration or bio-remediation, are also responsible for changing the local spatial distribution of fluid velocities. The rheology of non-Newtonian fluids (that show a shear rate dependence of their viscosity) combined with the complex pore structure present in most man-made and natural porous media makes predicting the flow distribution challenging. In this work a novel experimental approach is used to quantify and explain the pore-scale velocity distribution of Newtonian and shear-thinning fluids. By tracking suspended fluorescent particles via time-lapse video-microscopy we measure the tracer velocity distribution. Our experiments showed a deviation of the shear-thinning fluid velocity distribution from its Newtonian counterpart when a low pressure gradient is driving the overall flow. This deviation seems to disappear as the driving pressure drop increases.