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Contribution ID: **364** Type: **Oral Presentation**

Pore-scale imaging of unsaturated solute transport to determine the influence of fluid distribution on solute spreading and mixing

Monday, 31 May 2021 18:45 (15 minutes)

Solute transport in unsaturated porous media is a key process for various applications, such as groundwater flow and building stone performance. The distribution of the immiscible fluids controls which parts of the pore space are accessible for solute transport. This may lead to a bimodal velocity distribution in the solvent phase with stagnant and flowing regions (Jiménez-Martinez et al., 2017), characterized by non-Fickian solute transport. Hasan et al. (2019) showed that there are still fundamental inconsistencies between different modelling approaches, spurring the need for experimental validation. However, due to methodological challenges there are only few experimental studies that target unsaturated solute transport in rocks at the pore scale (Hasan et al., 2020).

In this study, we visualized the spreading of a solute through partially water-saturated sintered glass and Bentheimer sandstone samples. After a drainage and imbibition cycle with water and n-decane, leaving a significant amount of the latter trapped in the pore space, an aqueous tracer solution (10 wt% KI) was injected with a constant flow rate. Transient pore-scale concentration fields in the sample were imaged in 3D by using fast laboratory-based X-ray micro-CT (time resolution of 15 s, voxel size of 13 µm). To determine the influence of the non-wetting phase on the solute transport, single-phase experiments were also performed on the same samples. By extracting a pore network and performing a pore-scale image analysis work flow (Van Offenwert et al., 2019) we investigated the existence of stagnant and flowing regions. Furthermore, we studied the influence of the fluid phase distribution on solute mixing and spreading. These results can improve our understanding of non-Fickian solute transport. Our novel methodology can also be used to validate two-phase solute transport simulations in rock types with different pore-scale heterogeneity.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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