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Contribution ID: **177** Type: **Poster (+) Presentation**

Using PIV and 3D printing to investigate fluid flow and solute transport in fractured porous media.

Tuesday, 1 June 2021 10:00 (1 hour)

Preferential flow-paths are well-known features in fractured rock masses, often allowing rapid movement of fluid and early breakthrough of solutes and/or heat/cold in a small fraction of void space, compared to non-fracture-dominated porous media. These preferential flow-paths can change as the configuration of fractures varies, due to, for example, shear displacement (Yeo et al.,1998; Kluge et al.,2017) or bifurcations (Li,2002; Johnson et al.2006). Such changes could become particularly important for subsurface projects, such as geothermal energy utilization, reservoir enhancement, and hydrometallurgy. Although numerical studies have shed some light on the preferential flow path and fluid behavior in rough fractures, experimental visualization and, more importantly, quantification of flow paths in rough-walled fractures still remains a challenge.

In this work, we show how to record and quantify fluid velocities and solute transport rates through a rough fracture using Particle Imaging Velocimetry (PIV) measurements, which have been rarely applied in the geosciences (S.H. Lee et al.,2015; Ahkami et al., 2018). During PIVmeasurements, a solution of mineral oil and trans-anethole is prepared to match the refractive index of the clear 3D-printed fractures. This solution serves as the working fluid, seeded with nearly neutrally-buoyant fluorescent particles. In the first study, the PIV results on a single, rough, shear-able fracture will be compared to numerical simulations using the local cubic law. In the second study, we visualize solute transport and fluid flow through a bifurcating rough-walled fracture, quantified by PIV measurements and lattice-Boltzmann simulations.

Time Block Preference

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

References

Yeo, I. W., De Freitas, M. H. & Zimmerman, R. W. Effect of shear displacement on the aperture and permeability of a rock fracture. Int. J. Rock Mech. Min. Sci. 35, 1051–1070 (1998).
Kluge, C., Milsch, H. & Bl˙ocher, G. Permeability of displaced fractures. Energy Procedia 125, 88–97 (2017).
Li, G. (2002). Tracer mixing at fracture intersections. Environmental Geology, 42(2-3):137–144.
Johnson, J., Brown, S., and Stockman, H. (2006). Fluid flow and mixing in rough-called fracture intersections. Journal of Geophysical Research: Solid Earth, 111(12):1–16.
Ahkami, M., Roesgen, T., Saar, M. O. & Kong, X.-Z. High-Resolution Temporo-EnsemblePIV to Resolve Pore-Scale Flow in 3D-Printed Fractured Porous Media. Transp. Porous Media129, 467–483 (2019).
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Student Poster Award

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