
Contribution ID: **322** Type: **Poster Presentation**

# Bacterial chemotaxis in heterogeneous porous media in the presence of nutrient hot spots and flow

*Wednesday, 24 May 2023 10:30 (1h 30m)*

Subsurface porous systems, like soils and aquifers, are physically and chemically highly heterogeneous. Especially on the microscale, chemical hot spots and heterogeneous pore-sizes, which lead to a wide range of fluid flow velocities and strong local gradients, control the physico-chemical landscape. Microorganisms capable of biasing their motion to swim along these chemical gradients –known as chemotaxis –profit from their ability to navigate towards nutrient hot spots, such as contaminant droplets, soil aggregates or plant roots. This ability and their ubiquitous presence in natural subsurface systems gives them an important role for triggering reactions on the pore-scale for the availability of nutrients, the degradation of contaminants or soil respiration.

We developed a novel experimental microfluidic platform to study chemotaxis in the presence of chemical hot spots in porous media under flow conditions. In this multi-layered polydimethylsiloxane (PDMS) device, hydrogel features are embedded into the porous medium, acting as diffusive point sources. The experimental platform is giving both, full optical access to the pore-space and spatio-temporal control over the physico-chemical landscape. The nutrient plumes formed downstream of the hot spots under flow drive the swimming of chemotactic bacteria. By tracking the swimming of single cells under different flow conditions, we can link the bacterial behaviour to physical, chemical and hydrodynamic heterogeneities. This enables the study of the response of chemotactic bacteria to pore-scale chemical gradients and sheds new light onto the transport of microorganisms in the subsurface.

## Participation

In-Person

## References

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**Session Classification:** Poster

**Track Classification:** (MS05) Biochemical processes and biofilms in porous media