Optical resolution of chemical mixing in flows through rocks and soils

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Project Description:

The mixing of chemicals in flows through Earth's porous subsurface controls numerous environmental and energy related processes, ranging from carbon dioxide sequestration to groundwater remediation. While fluid mixing is well understood in unconfined fluid flows, our understanding remains limited in flows through the complex interiors of rocks and soils, where interplay between the solid grains and flowing water controls the mixing process.

In this project, students will collaborate with researchers at the PoreLab Center of Excellence to develop new laboratory experiments that resolve the fluid dynamics of chemical mixing in porous media flows. We have already established methods to fabricate transparent porous media with 3D printing and and optically image fluid mixing within them using fluorescent particles and dyes.

We intend for students to extend these techniques, explore a wider range of experimental conditions than previously resolved, and improve our understanding of fluid mixing in Earth's subsurface. Projects will develop students' laboratory fabrication, optical imaging, and data analysis skills. Students will summarize their results in a report which with potential to develop into a publication. Students will be encouraged to present their findings at a scientific conference to their professional development.

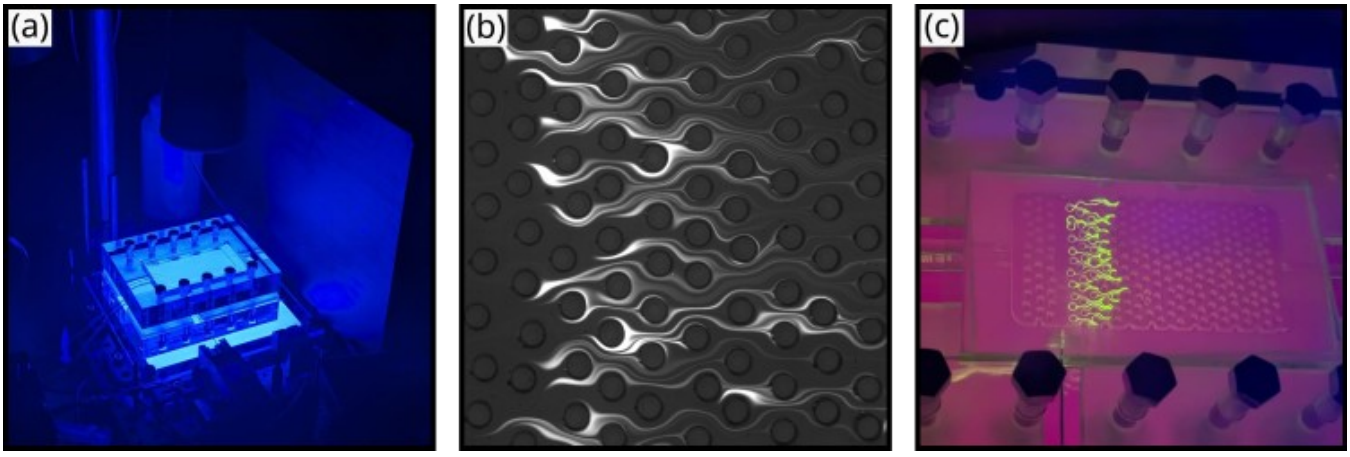

Figure 1: a) Experimental setup to study mixing; (b) Filamentary structure in a chemical concentration field; (c) Close up view of one fluorescence-based imaging technique

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Practical Information:

Supervisors:	Kevin Pierce, Paula Reis, Khobaib Khobaib, and Gaute Linga – all young postdocs and researchers at Porelab SFF and the Njord Centre
Preferred student backgrounds:	Physics, Geoscience, Mathematics, or Engineering, with interest in fluid dynamics or hydrology. Optics, fabrication, or programming experience would be an advantage. Specific projects will be tailored to students' skills. We welcome applicants with diverse backgrounds
Number of available projects:	Two projects, with flexibility to adapt either to bachelor or master level students
Preferred project period:	Six week duration beginning in April or May. Reduced hours are possible for an extended duration
Expected deliverables:	A web-based report summarizing methodology and results on the fluid dynamics underlying mixing processes in porous media flows