NTU DOCTORAL SCHOOL

NOTTINGHAM TRENT UNIVERSITY

"Creating future innovators and impact for education, industry, the professions and society"

School of Science and Technology PhD Studentship – 2016/17 Entry

Dr Lucas Goehring – Flows in responsive porous media

As soil dries, or methane hydrates grow into deep-sea mud, or we sequester liquid CO2 back into exploited oil-reservoirs, fluids flow through highly tortuous, complex porous media, and potentially modify the geometry of their environment as they move. These are obviously challenging problems to simulate; yet there are strong motivations in agriculture, civil engineering, the energy sector, and the earth sciences, to understand such issues
competently.

This project will investigate how fluid invasion into a porous medium, as occurs in all these problems, induces changes to the geometry of that medium by (i) mechanical and (ii) chemical deformation, and then responds to those same changes. In both cases a complex two-way feedback exists between the flow and the evolution of transport properties such as porosity and permeability, which in turn dictate how flow will proceed.

To study these processes experimentally we will use microfluidic techniques (a.k.a. the 'lab-on-a-chip') to produce fully customizable materials, where the position and geometry of every microscopic feature can be prescribed. These chips will then serve as a reusable, reproducible 'scaffold' for the fluid flow experiments, which will involve the injection of fluids under pressure, or fluids that react with each other to produce a hard precipitate. The experiments will focus on understanding the conditions, expressed as simple dimensionless ratios of forces or rates, under which different types of fluid invasion patterns will form.

The results of this work will also feed into a larger collaborative project with researchers from the Hebrew University of Israel. They will aim to use your results, with exactly defined geometries and high-precision measurements of fluid invasion patterns, to help build, train, and rigorously truth-test, a powerful new class of pore-network models, which has the potential for wide-spread application in areas like understanding groundwater contamination; drying of arid soils; enhanced oil recovery; damage-mitigation of boreholes; carbon capture and storage; methane hydrate formation; and so on.

Specific qualifications/subject areas required of the applicants for this project:
To be eligible to apply, you must hold, or expect to obtain by 1st April 2017, a BSc Hons (2:1 or above) (or UK equivalent according to Naric) in Physics or a related discipline.

For informal discussion regarding the project, please contact: lucas.goehring@ntu.ac.uk