ECOLE LEMANIQUE DES SCIENCES DE LA TERRE
DES UNIVERSITES DE GENEVE ET DE LAUSANNE

Master ès Sciences
in Earth sciences

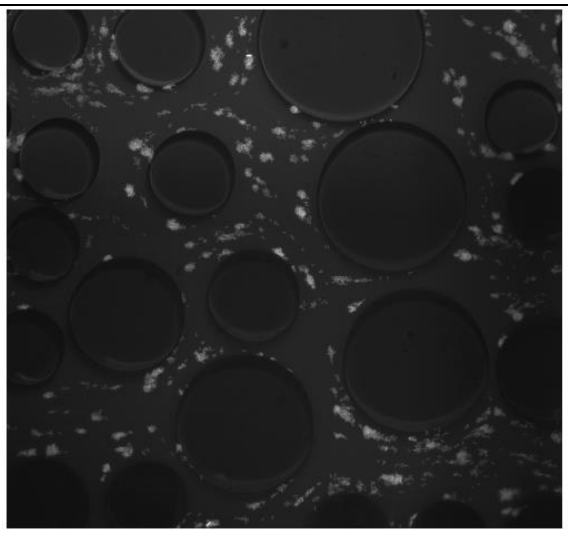
Modeling fluid flow to study nutrient transport and microbial growth in porous media

Contact persons
Pietro de Anna (pietro.deanna@unil.ch); Beatriz Quintal (beatriz.quintal@unil.ch)

Context
Biofilm growth in porous material is an important process that controls reactions, fluid flow and filtration processes. The system permeability may decrease when clogging (the pore space obstruction by growing biomass) takes place within the host medium. As a result, the flow through a filter or an aquifer may be dramatically reduced. This may have important consequences on industrial systems such as geothermal energy production or on filters' efficiency in waste water treatment plants.

Objectives and Methods
This project aims at the investigation of the microbial growth that leads to the pores clogging and the resulting medium permeability reduction. We will use the software COMSOL Multiphysics to numerically simulate the average fluid motion through a porous material at the so-called Darcy-scale (without resolving the porous structure) and understand the relationship between the local and global hydraulic conductivity. We will develop a theoretical model to infer the hydraulic conductivity field from microfluidics experiments (already performed). Once the flow solution is computed we will simulate nutrient transport and uptake (microbial consumption). The first goal of this project is to understand the impact of microbial growth on the host medium hydraulic properties, by defining the relationship between the local microbial space occupancy and hydraulic conductivity. The second goal is to improve our understanding of microbial growth when limited by nutrient transport through porous media, where flow is decreasing due to its coupling to the microbial growth itself.

Literature



WEB sites

Choice of orientation
1) Sedimentary, Environmental and Reservoir Geology