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

Master ès Sciences in geology

The role of biofilm on unconsolidated material deformation

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Context

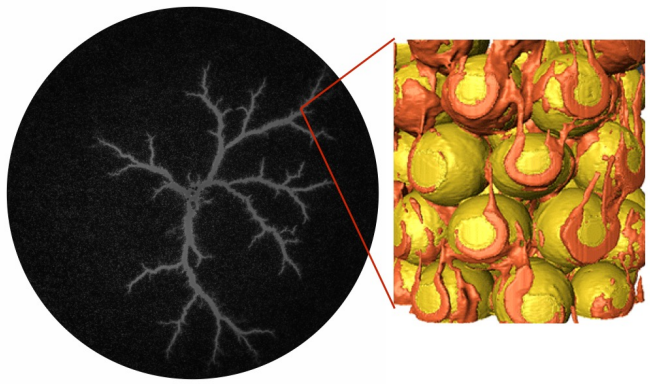
A large part of bacteria live in the subsurface attached to solid surfaces: during microbial growth, the production of biomass is also associated to the production of a viscous/sticky substance, the EPS (Extra-cellular Polysaccharide Structures), that provide a solid frame for the microbial communities: the biofilms. The growth of these biofilm structures can dramatically impact the medium flow properties, such as porosity or hydraulic conductivity, by clogging pores, or increasing grain surface roughness, as well as their surface area. Their action could also be responsible for modifications of the mechanical properties of the host medium, such as their resistance to fractures propagation.

Objectives and Methods

To investigate the impact of biofilm on deformation and fractures propagation, the research will be performed with laboratory experiments with a circular Hele-Shaw cell filled with small glass beads under a confining stress (a weight), mimicking an unconsolidated porous material. The glass beads (the grains) surface will be initially colonized by a bacterial population, in the form of biofilm. Once the biofilm will be formed, from the center of the cell a viscous fluid will be injected and will, eventually, displace some of the glass beads opening fractures to facilitate its own flow. Images of the flowing cell will be continuously taken, in order to dynamically quantify the produced displacement via a a posteriori quantitative image analysis. By comparing experiment with and without biofilm it will be possible to estimate the role of these structures on the medium deformation. This research requires the use classical photography, growing microbial populations, use of pumps and pressure controllers and quantitative image analysis.

Literature

Atekwana et al. Biogeophysics: a new frontier in earth science research, (2009) Reviews of Geophysics
Douarche et al. Bacillus subtilis bacteria generate an internal mechanical force within a biofilm, (2015) Biophysical Journal



WEB sites

Choice of orientation : (supprimer les orientations qui ne conviendraient pas)

1) Sedimentary, Environmental and Reservoir Geology