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Particles transport and sedimentation in heterogeneous porous media

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Anomalous transport of solutes and suspensions in confined environments have drastic consequences for biogeochemical processes, including chemical reactions and microbial activities. While the impact of the host medium structural heterogeneity on transport has been investigated extensively, little is known about the coupling between such heterogeneity and sedimentation associated to density mismatch between the transported substance and the surrounding fluid. Recently, it has been shown that the sedimentation profile of a diluted colloid suspension, transported by a homogeneous flow field through a planar fracture, decays as the inverse of the square root of the distance from inlet.

Here, we use microfluidics and time-lapse video-microscopy to investigate the impact of host medium heterogeneity on Brownian particles sedimentation in a suspension with a low volume fraction. We compare longitudinal sedimentation profiles in homogeneous and heterogeneous horizontal flow conditions. Our preliminary results show that: i) when performing the experiment in a homogeneous velocity field (a straight channel, mimicking a fracture), we determine that the sedimentation profile follows the inverse of the square root of the distance from the inlet, ii) using a porous medium replica, made out of cylindrical pillars of random size and position, the sedimentation profiles deviate from the one obtained in homogeneous conditions, iii) in both cases, the number of sedimented particles at the beginning traveled distance is lower than expected, due to a vertical heterogeneous distribution of particles in the suspension.

Our work illustrates that heterogeneous porous material will impact the sedimentation and could be a contribution to comprehension of particle aggregates or bacteria sedimentation.