Long term flocculation of clay in microgravity under g-jitter

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We performed a campaign of microgravity experiments on board the International Space Station (ISS) combined with particle-resolved Direct Numerical Simulations (pr-DNS) to study the flocculation behaviour of kaolin suspension in the absence of gravity. The experimental setup was built upon a previous campaign that investigated the settling of kaolin in saline water (Rommelfanger et al., 2020). The cuvettes were prepared in an Earth-bound laboratory with saline water with 35 PSU and a clay suspension of 8 ppt and then delivered to the ISS. The suspension was monitored by taking pictures at regular time intervals over a period of more than 100 days (Figure 1a). Image analyses show that the average aggregate diameter grows as $d \sim t^{0.5}$, which is more rapidly than would have been expected from Brownian motion. We, hence, hypothesize that the aggregation growth is partly due to the jitter aboard the ISS. We performed corresponding pr-DNS following the scheme proposed by Vowinckel et al. (2019) to reproduce the growth of clay aggregates in a more controlled setting. To this end, spherical primary particles were randomly placed in a triple-periodic box and exposed to an oscillatory flow to mimic jittering motion (Figure 1b). Larger simulations that will reveal the governing mechanisms of enhanced aggregate growth are underway.

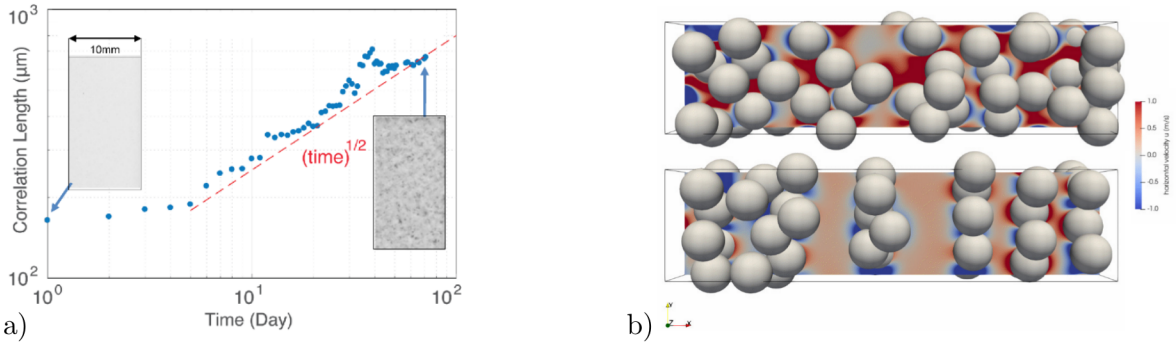

Figure 1: a) Correlation length of particle aggregates and b) preliminary simulation result with 52 particles in a horizontally oscillating flow. Top: initial configuration; bottom: after 100 oscillation periods.

References

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