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Using colloidal deposition to mobilize immiscible fluids from porous media

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Colloidal particles hold promise for mobilizing and removing trapped immiscible fluids from porous media, with implications for key energy and water applications. Most studies focus on accomplishing this goal using particles that can localize at the immiscible fluid interface. Therefore, researchers typically seek to optimize the surface activity of particles, as well as their ability to freely move through a pore space with minimal deposition onto the surrounding solid matrix. Here, we demonstrate that deposition can, surprisingly, *promote* mobilization of a trapped fluid from a porous medium without requiring any surface activity. Using confocal microscopy, we directly visualize both colloidal particles and trapped immiscible fluid within a transparent, three-dimensional porous medium. We find that as nonsurface active particles deposit on the solid matrix, increasing amounts of trapped fluid become mobilized. We unravel the underlying physics by analyzing the extent of deposition, as well as the geometry of trapped fluid droplets, at the pore scale: deposition increases the viscous stresses on trapped droplets, overcoming the influence of capillarity that keeps them trapped. Given an initial distribution of trapped fluid, this analysis enables us to predict the extent of fluid mobilized through colloidal deposition. Taken together, our work reveals a new way by which colloids can be harnessed to mobilize trapped fluid from a porous medium.

Time Block Preference

Time Block B (14:00-17:00 CET)

References

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Primary authors: Ms SCHNEIDER, Joanna (Princeton University); Prof. PRIESTLEY, Rodney (Princeton University); Prof. DATTA, Sujit (Princeton University)

Presenter: Ms SCHNEIDER, Joanna (Princeton University)

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