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Understanding the Effects of Hydrodynamics and Capillarity on the Remobilization of Colloids in a PDMS Micro-model

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Colloids-facilitated transport can enhance contaminants transport from the vadose zone to groundwater. It has received significant academic attention in recent years.
In the recent literature, it was found that colloids mobilization occurs with the moving fluid-fluid interfaces. But, mobilization has been usually investigated either in column experiments by measuring concentration at the outlet, or was visualized in a capillary channel. Through column experiments, it's difficult to tell the underlying mechanisms; at pore scale, visualization in a single channel couldn't represent the behavior of colloids through a porous medium.
The objective of this study was to investigate colloids remobilization as a function of flow rate of the invading fluid and interfacial tension, during the process of draining or imbibing the system. To investigate the role of flow rate in colloids remobilization, saturation had been kept constant; two flow rates were controlled by a syringe pump. The surface tension was modified by adding surfactants.
By using a confocal microscope, fluorescent intensities of the colloids were measured at the outlet of the flow network with an interval of 834ms. Afterwards, colloids concentration was calculated according to the measured calibration curve. Concurrently, sequential images of the flow network were taken at a speed of 1frame per 834ms. These images were processed to video images to give information during the dynamic process. Combined results of BTC and video images provide valuable information to help understand the mechanisms of colloids retention and remobilization as a result of invading fluid flow rate, as well as the interfacial tension.