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Colloid Transport in Unsaturated Porous Media: On the Role of the Liquid-Gas Interface

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Colloid transport in unsaturated porous media is not only affected by solid-liquid interfaces, but also by the presence of a liquid-gas interface. Many experiments have demonstrated that the liquid-gas interface plays an important role in colloid retention and mobilization during unsaturated flow; however, the exact mechanisms on how colloids interact with the liquid-gas interface are still under debate. In this presentation, current knowledge on colloid-liquid-gas-interface interactions will be summarized and discussed. The experimental evidence will be interpreted with DLVO and thermodynamic considerations. It will be shown that the interactions between colloids and the liquid-gas interface are very strong: much stronger than interactions between colloids and the liquid-gas interface. It will further be shown that the attachment of colloids to the liquid-gas interface is thermodynamically always favorable. Direct force measurements between colloids and the liquid-gas-interface will be presented and used to demonstrate the paramount importance of the liquid-gas-interface on colloid fate and transport in unsaturated porous media. As the liquid-gas interface changes its configuration with changing water saturation, the forces controlling colloid retention and mobilization are dynamic.