Co-injection of alcohols and carbonated water to reduce the risk of downward migration of DNAPLs during the remediation

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Removal and remediation of dense non-aqueous phase liquids (DNAPLs) in subsurface are difficult to prevent its pollution on groundwater. The current common remediation methods are flushing with surfactants and co-solvents. The flushing efficiency is improved by increasing solubility and mobility of DNAPLs, which will result to the risk of downwards migration of DNAPLs and increasing the region of contamination. Co-injection of alcohols and carbonated water has the potential to reduce such risks and prevent the downward migration, by controlling the relative density of DNAPL to flushing solution and increase the buoyant effect. At present, we measured the density changes of DNAPLs after co-injecting of carbonated water and alcohols. We found that the density of DNAPL decreases with increasing concentration of alcohols and CO_2. We also used Raman quantitative spectroscopy to determine the phase equilibrium of water, ethanol and DNAPL ternary system. The concentration of DNAPL in aqueous phase increases with increasing the amount of ethanol. When the amount of ethanol exceeds one certain value, the water and the DNAPL are miscible and can form a homogeneous solution. We are going to experimentally simulate the flushing processes of co-injection of carbonated water and alcohols in the transparent micro-model, to study the migration and distribution of DNAPLs under the different kinds of flow morphology controlled by capillary, gravity and viscous forces. Such study will help us to understand how to reduce the risk of site flushing, optimize the DNAPL remediation technologies and improve the DNAPL removal efficiency.