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Dissertation summary

Dissolution mass transfer of trapped phases to water in porous media is important in various hydrogeology processes, such as groundwater contamination, groundwater in-situ bioremediation, and geological carbon sequestration. It is pointed out that the mass transfer coefficient and the specific surface area in the case of dissolution mass transfer in porous media cannot be quantified independently due to limitation in visualization technology. In this work, this phenomenon was investigated using micro-tomography and a series of image processing techniques. Bottom-up investigation was then performed from pore-scale. First, porous media characteristics, i.e., porosity, pore size distribution, and throat size distribution, of several porous media were investigated. Second, the capillary trapping characteristics, i.e., trapped phase saturation, bubble size distribution, bubble morphology, and specific interfacial area, in these porous media were examined. Third, the initial fluid displacement patterns were investigated. Viscous and capillary fingering displacement pattern, which is the most likely displacement patterns that occur in hydrogeology, were investigated. Afterwards, the dissolution mass transfer processes were investigated under various conditions of porous media characteristics, fluid velocity, and trapped phase properties. At the end, a model of specific interfacial area and a mass transfer model for dissolution in porous media were developed.