Reactive Transport Modeling of CO2 in Carbonate Rocks: Single Pore Model

P. Agrawal[1], J. Koskamp[1], A. Raoof[1], M. Wolthers[1]

[1]Utrecht University, Utrecht, The Netherlands

Abstract

Dissolution of calcite plays an important role in various processes such as enhanced oil and gas recovery, CO2 sequestration, and groundwater transport for the drinking water production. Dissolution rates predicted by pore scale and continuum scale models are often faster than the observed laboratory rates (Molins et.al., 2014). This discrepancy suggests that the importance of pore scale processes and so as the requirement for research.

Evolving pore structure and size is controlled by reaction kinetics and flow properties. We would like to include impact of solution stoichiometry and surface roughness in reaction kinetics which have already been observed on molecular scale. In our COMSOL Multiphysics® model, solid pore walls move due to the surface reactions because of calcite dissolution.

We observe that the regime of flow is a key factor controlling dissolution. For fluid velocity around 1x10-8 m/s there is no significant dissolution (Figure 1). By increasing velocity with two orders of magnitude, drastic changes in dissolution pattern and subsequent pore geometry evolution is seen mostly near the inlet, because of saturation with respect to calcite along the flow path. The same observations are noted for curved pore walls. Higher velocity is expected to have more penetration of reaction front and to bring out more characteristic difference in pore shape evolution pattern for rough pore walls. Our objective is to relate pore volume change with macroscopic properties such as porosity and permeability for different peclet numbers which will be used as an input for pore scale simulation in PoreFlow.

Figures used in the abstract

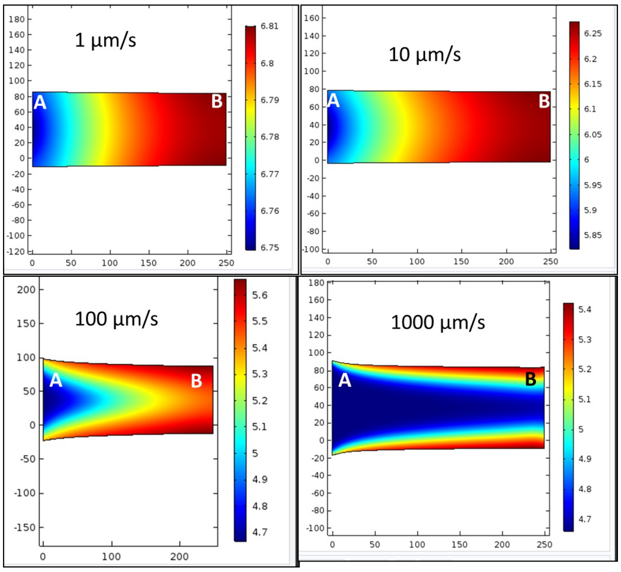

Figure 1: pH comparison for different velocity.