Fractures are the preferential flow pathways in the subsurface environment, and are subject to alteration caused by coupled geochemical-mechanical-hydrological-thermal processes triggered by mineral-fluid interactions. Improved understanding of fracture evolution is critical for the assessment and prediction of the performance of various geological systems associated with subsurface energy harness and storage, resources (e.g. groundwater and minerals) recovery, waste disposal and etc.. My research puts an emphasis on the coupled geochemical and hydrological processes that affect fracture evolution in heterogeneous porous media. The objectives are (1) to provide fundamental understanding of mechanisms that control fracture alteration at the pore- and core-scale, and (2) to develop predictive models and constitutive relations for effective integration of fine scale processes and heterogeneity into large scale analysis.

In this talk, I will present core-scale simulation results from a reactive transport model that was developed and validated based on laboratory experiments. The numerical experiments were performed under a range of flow, geometric and mineralogical conditions, and used to develop a multi-reaction Damköhler number for the prediction of fracture evolution in multi-mineral systems. This framework provides important implications for caprock integrity in geologic carbon storage systems. I will also present a pore-scale investigation of the compound effects of surface roughness on reaction rates of a single rough fracture. In addition to providing mechanistic understanding of the interplay between flow, transport and reactions at extremely fine scale, the simulations were used to develop upscaling rules such that pore-scale processes arising from surface roughness can be accounted for in continuum-scale models effectively.

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Dr. Hang Deng is a post-doc fellow in the Earth and Environmental Sciences Area at Lawrence Berkeley National Laboratory. She received her Ph.D. in Civil and Environmental Engineering from Princeton University in 2015, and her B.S and B.A from Peking University in 2009. Her research interests are to advance fundamental understanding of the evolution of fractured porous media caused by coupled chemical-physical processes across scales and to inform various subsurface practices, including geologic carbon storage. For the investigations, she uses a suite of characterization techniques (e.g. high resolution microtomography), experimental tools (e.g. fracture flow experiment) and numerical models (e.g. computational fluid dynamics). Her current research focuses on water-mineral interactions and the controls of geochemical and geometric heterogeneity at pore- and core-scales on fracture alteration using reactive transport modeling. As a broadly trained environmental scientist, she dedicates her research to the resolution of pressing challenges regarding energy, water and environment.