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the impacts of pore-scale two-phase flow on mineral reaction rate

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In various natural and engineered systems, multi-phase flow and mineral-fluid interactions co-occur and their interplay controls the evolution of these systems. In continuum scale models, how multiphase flow dynamics affect mineral reactions are rarely accounted for or are corrected via reactive surface area and saturation of the aqueous phase. To evaluate the applicability of such treatment, understanding of the pore-scale dynamics is required. In this study, we developed a framework that couples the two-phase flow simulator from OpenFOAM with the geochemical reaction capability of CrunchTope, to examine pore-scale dynamics of two phase flow and their impacts on mineral reaction rates. For our investigations, flat 2D channels and single sine wave channels were used to represent smooth and rough geometry. Calcite dissolution in these channels were quantified with single phase flow and two phase flows with different saturations. We observed that the bulk calcite dissolution rates were not only affected by the loss of reactive surface area as it becomes occupied by the non-reactive non-aqueous phase, but also largely influenced by the changes in local velocity profiles due to the presence of then non-aqueous phase. The extent of the changes in reaction rates in the two-phase systems compared to the corresponding single phase system is dependent on the flow rate (i.e., capillary number) and channel geometry. The pore-scale simulation results can be used to better constrain reaction rate descriptions in multiphase continuum scale models.

Time Block Preference

Time Block C (18:00-21:00 CET)

References

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