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Estimation of unknown parameters to improve modeling of Microbially Induced Calcite Precipitation

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One of the key issues of underground gas storage is the long-term security of the storage site. Amongst the different storage mechanisms, cap-rock integrity is crucial for preventing leakage of the stored gas due to buoyancy into shallower aquifers or, ultimately, the atmosphere. This leakage would reduce the efficiency of underground gas storage and pose a threat to the environment. Ureolysis-driven, Microbially Induced Calcite Precipitation (MICP) is one of the technologies in the current focus of current research aiming at mitigation of potential leakage by sealing high-permeability zones in cap rocks.

Previously, a numerical model, capable of simulating two-phase flow and MICP processes, was developed and validated against MICP experiments [1]. The model has been improved based on new experimental findings of our collaborators at MSU with respect to the microbial ureolysis kinetics as well as the impact of biomineralization on permeability. The number of fitting parameters used in the model has been reduced and the remaining ones have been refitted by inverse modeling. With the improved implementation of those processes relevant for modeling MICP, simulation results are expected to better match the observed features of a variety of MICP experiments in different porous media, flow regimes and under varying injection schemes conducted by our collaborators at MSU.

References

[1] A. Ebigbo, A.J. Phillips, R. Gerlach, R. Helmig, A.B. Cunningham, H. Class, L.H. Spangler. Darcy-scale modeling of microbially induced carbonate mineral precipitation in sand columns. Water Resources Research, 48, (2012)