Geophysical Research Abstracts
Vol. 18, EGU2016-1177, 2016
EGU General Assembly 2016

Finding a balance between accuracy and computational effort for modeling biomineralization

Johannes Hommel (1), Anozie Ebigbo (2), Robin Gerlach (3), Alfred B. Cunningham (3), Rainer Helmig (1), and Holger Class (1)

(1) University of Stuttgart, Institute for Modelling Hydraulic and Environmental Systems, Department of Hydromechanics and Modelling of Hydrosystems, Stuttgart, Germany (johannes.hommel@iws.uni-stuttgart.de), (2) Imperial College London, Faculty of Engineering, Department of Earth Science & Engineering, London, UK, (3) Montana State University, Center for Biofilm Engineering, Bozeman, MT, USA

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 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 multi-component reactive transport, including the most important processes necessary to describe MICP, was developed and validated against experiments in *Ebigbo et al.* [2012]. The microbial ureolysis kinetics implemented in the model was improved based on new experimental findings and the model was recalibrated using improved experimental data in *Hommel et al.* [2015]. This increased the ability of the model to predict laboratory experiments while simplifying some of the reaction rates.

However, the complexity of the model is still high which leads to high computation times even for relatively small domains. The high computation time prohibits the use of the model for the design of field-scale applications of MICP. Various approaches to reduce the computational time are possible, e.g. using optimized numerical schemes or simplified engineering models.

Optimized numerical schemes have the advantage of conserving the detailed equations, as they save computation time by an improved solution strategy. Simplified models are more an engineering approach, since they neglect processes of minor impact and focus on the processes which have the most influence on the model results. This allows also for investigating the influence of a certain process on the overall MICP, which increases the insights into the interactions of different processes and the relative importance of each process for the overall MICP. An additional motivation for this approach is that for field applications, the important input parameters such as porosity and permeability are not known reliably. In light of this uncertainty related to the input-parameter identification, excessively detailed equations might be an unnecessary burden to modeling MICP as the overall reliability of the model predictions already is highly influenced by the uncertainty of these input parameters.

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)

J. Hommel, E. Lauchnor, A.J. Phillips, R. Gerlach, A. B. Cunningham, R. Helmig, A. Ebigbo, H. Class. A revised model for microbially induced calcite precipitation - improvements and new insights based on recent experiments. *Water Resources Research*, **51**, 3695-3715, (2015)