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Flow, transport, and microbial activities in engineered subsurface applications: numerical modeling and experimentation

Johannes Hommel, Holger Class

University of Stuttgart, Germany
iwshclas@iws.uni-stuttgart.de

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Abstract. *Induced calcite precipitation is an engineering technology that allows for a targeted sealing of flow paths in the subsurface. This can be, for example, an important countermeasure to prevent leaking of fluids from subsurface reservoirs. A major difficulty is to prepare the local pH value to favourable conditions for calcite precipitation. This can be achieved with biofilms that express an enzyme that hydrolyses urea and, by this, increases the pH. Modeling such processes is challenging for different reasons. First, this requires solving different balance equations for flow and transport of single or multiple phases and a number of different components; furthermore reaction kinetics, attachment/detachment and growth/decay of biomass; and in particular the alteration of pore space by biofilms or precipitated calcite.*

Another example addresses microbially enhanced coal-bed methane production, where microbial activity is suspected to enhance the release of methane. While these processes are not yet fully understood in detail, numerical models are an important tool to help designing experimental research.

We will present the conceptual models and the governing equations. Then, we discuss the problem of model validation and possibilities to use it for experimental design and preparation of field activities and we will give examples.