Application of Magnetic Resonance Imaging to assess changes in transport properties of porous media due to dissolution and precipitation processes

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The understanding of porosity changes due to mineral dissolution/precipitation and its impact on solute transport in porous media is important, for example, with respect to contaminant transport in the subsurface, CO_2-sequestration, or the performance assessment of geological disposal facilities for radioactive wastes. The implementation of such coupled processes into numerical codes requires a mechanistic understanding of the relevant precipitation and dissolution processes in porous media and model validation with quantitative experiments. In this context, we conducted flow through column experiments to investigate the effects of barite and gypsum precipitation in porous media, respectively, and consequential changes in porosity and permeability. The experiments were modelled using the reactive transport code OpenGeosys-GEM. However, the Kozeny-Carman equation, which is widely applied in reactive transport codes to describe porosity and permeability changes due to dissolution/precipitation processes, distinctively underestimated the permeability changes observed in our experiments. Instead, a porosity-permeability relationship involving a critical porosity had to be considered in the simulations to reproduce the experimental findings. To gain a mechanistic understanding of the physical meaning of the so called critical porosity, magnetic resonance imaging (MRI) was applied for the *in-situ* evaluation and quantification of the changes in porosity and pore connectivity in the reactive column experiments. This approach will enable to obtain process specific porosity/permeability relations, in this case due to mineral precipitation, which can be introduced into reactive transport simulations.