Geophysical Research Abstracts
Vol. 16, EGU2014-11757, 2014
EGU General Assembly 2014

Multi-scale modeling of multi-component reactive transport in geothermal aquifers

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In deep geothermal systems heat and chemical stresses can cause physical alterations, which may have a significant effect on flow and reaction rates. As a consequence it will lead to changes in permeability and porosity of the formations due to mineral precipitation and dissolution. Large-scale modeling of reactive transport in such systems is still challenging. A large area of uncertainty is the way in which the pore-scale information controlling the flow and reaction will behave at a larger scale. A possible choice is to use constitutive relationships relating, for example the permeability and porosity evolutions to the change in the pore geometry. While determining such relationships through laboratory experiments may be limited, pore-network modeling provides an alternative solution.

In this work, we introduce a new workflow in which a hybrid Finite-Element Finite-Volume method [1,2] and a pore network modeling approach [3] are employed. Using the pore-scale model, relevant constitutive relations are developed. These relations are then embedded in the continuum-scale model. This approach enables us to study non-isothermal reactive transport in porous media while accounting for micro-scale features under realistic conditions. The performance and applicability of the proposed model is explored for different flow and reaction regimes.

References:

1. Matthäi, S.K., et al.: Simulation of solute transport through fractured rock: a higher-order accurate finite-element finite-volume method permitting large time steps. Transport in porous media 83.2 (2010): 289-318.

2. Nick, H.M., et al.: Reactive dispersive contaminant transport in coastal aquifers: Numerical simulation of a reactive Henry problem. Journal of contaminant hydrology 145 (2012), 90–104.

3. Raoof A., et al.: PoreFlow: A Complex pore-network model for simulation of reactive transport in variably saturated porous media, Computers & Geosciences, 61, (2013), 160-174.