Reactive Flow Model for Porosity Reduction by Quartz Dissolution/Precipitation

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Quartz dissolution and precipitation is an important pore reducing process in geothermal reservoirs. We present a single-phase reactive flow model coupled with hydrodynamic flow and heat transfer components and implement it into COMSOL Multiphysics. The model includes diffusion and advection, and analytical equations are used to describe quartz kinetics and equilibrium concentrations with respect to the silicate phases. The numerical model can be used to analyze the evolution of the porosity/permeability, and hence the productivity of the reservoir induced by heat extraction in geothermal reservoirs. A geothermal reservoir is modeled with realistic time steps, where its geometry is represented as a porous medium block in which chemical reactions occur between the pore fluid and the rock matrix. Future developments include adding a fracture and fracture networks to the system and analyzing the changes in effective stresses in the presence of reactive flow. Economic reservoir development requires a combined analysis of the thermo-hydro-mechanical and chemical processes, and precipitation processes may be important in post-seismic fluid flow processes.