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## Role of kinetics on the couplings between fluid flow, deformation and reaction

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Short timescale processes such as earthquakes, tremors and slow slip events may be influenced by reactions, which are known to proceed rapidly in the presence of water (typically several days). Here, we developed a theoretical framework to introduce the influence of mineralogical reactions on fluid flow and deformation. The classical formalism for dissolution/precipitation reactions is used to consider the influence of the distance from equilibrium and of temperature on the reaction rate and a dependence on porosity is introduced to model the evolution of the reacting surface area during reaction. The thermodynamic admissibility of the derived equations is checked and an analytical solution is derived to test the model. The fitting of experimental data for three reactions typically occurring in metamorphic systems (serpentine dehydration, muscovite dehydration and calcite decarbonation) indicates a systematic faster kinetics on the dehydration side than on the hydration side close from equilibrium. This effect is amplified through the porosity term in the reaction rate. Numerical modelling indicates that this difference in reaction rate close from equilibrium plays a key role in microtextures formation during dehydration in metamorphic systems. The developed model can be used in a wide variety of geological systems where couplings between reaction, deformation and fluid flow have to be considered.