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Rigorous derivation of an effective model for reactive transport in evolving porous medium

Tuesday, 1 June 2021 11:15 (15 minutes)

In this talk we derive a homogenized model for a reaction-diffusion equation describing mineral precipitation/dissolution in an evolving porous micro-domain, consisting of a fluid phase and a solid phase build by periodically distributed spherical solid grains. The evolution of the micro-domain depends on the concentration at the surface of the grains, leading to a free boundary value problem on the micro-scale. The periodicity and the size of the grains is of order ϵ, where the parameter ϵ is small compared to the size of the whole domain. The radius of every micro-grain depends on the concentration at its surface, leading to a nonlinear problem. The aim is to pass to the limit $\epsilon \to 0$ and rigorously derive a macroscopic model, the solution of which approximates the solution of the microscopic model.

In a first step we transform the problem on the evolving micro-domain to a problem on a fixed periodically perforated domain by using the Hanzawa-transformation, depending on the radius of the grains and therefore the concentration. This leads to a change in the coefficients of the equations, which now depend on the radius and the concentration, leading to a nonlinear problem. We prove existence using the Rothe-method and derive \textit{a priori} estimates for the solutions uniformly with respect to the parameter ϵ. For the derivation of the macroscopic model in the limit $\epsilon \to 0$ we use rigorous homogenization methods like the two-scale convergence. For the treatment of the nonlinear terms we need strong compactness results.

Time Block Preference

Time Block A (09:00-12:00 CET)

References

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