Title:

Multiscale Modeling Applied to Fractured Oil Shale Rock

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Given the complexity involved in modeling the oil shale recovery, a homogenization approach is needed in order to accurately account for the heterogeneity of geological formations. In this talk, we present an analytical approach for upscaling generalized linear and nonlinear flow and transport in porous media, when the formations can be described as a combination of block inclusions in a main matrix. The new result comes by using an approximation for a solution to a cell-problem that arises by applying two-scale asymptotic expansion for a given flow. By using a correction to this approximation, we obtain two important results: an analytical form for the upscale coefficient which gives an accurate averaged solution and an analytical basis function allowing a first-order approximation incorporating fine scale features into the averaged solution.

We illustrate the convergence properties when the rock formations can be regarded as a main matrix with block inclusions such as square and circular with heterogeneity ratio between inclusion and matrix given as 10:1, 100:1, 1000:1 and 1000:1. We demonstrate numerically that the procedure applies for linear and nonlinear flow equations as well as transport equations including certain types of random heterogeneity. We will also discuss the implementation of the approach for large scale simulations as well as its extension to fractured media. Since this is an analytical procedure, it has the desired property of portability as it can be used with existing codes.

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