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Sub-REV Homogenization of Flow in Porous Media with Isolated Embedded Fractures PATRICK JENNY, ETH Zrich — Classical homogenization relies on representative elementary volumes (REV) large enough that asymptotic macroscopic parameters, e.g. effective permeabilites, can be employed to describe the expected or mean behavior. In this way, Darcy's law, which describes the relationship between macroscopic pressure gradient and volumetric flow rate, was derived. In the presence of large features, however, the required REV size may reach the same order as the geometric reference scale of the problem, and thus effective permeabilities obtained from classical homogenization studies may be unsuited. This is in particular the case for reservoirs with isolated, highly conductive fractures. Here, a new sub-REV continuum model to describe the pre-asymptotic flow behavior in such media is presented. The model relies on a nonlocal multi-media description based on coupled integral-differential equations. The only empirical information required for calibration is the effective permeability of an infinitely large domain, e.g. as obtained from classical homogenization. With a series of numerical studies and comparison with Monte Carlo reference data it is demonstrated that the devised sub-REV model accurately captures mean flow rates and pressure profiles for arbitrary domain sizes.

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