Boundary Value Effects on Migration Patterns in Hydraulically Fractured Shale Formations

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Abstract

The subject of fluid flow in gas shales is one that has received a lot of attention in recent times, particularly since the techniques of horizontal drilling and hydraulic fracturing have made economic production from low permeability shale gas possible. In design of study models to optimize the production process however, the formation boundaries are assumed to be sufficiently impermeable as to be treated as a no-flux barrier to fluid movement out of the formation.

We intend to investigate a scenario that sometimes occurs during the hydraulic fracturing job, i.e. the case in which re-activation of closed/sealed faults and natural fractures lead to changes in the boundary conditions of the model. For computational tractability, the model domain is sized around a perforation cluster and the boundary conditions varied to capture the effects of the increased permeability in the domain.

We present a novel approach to modelling the hydraulic fractures in the formation by making use of a fractal representation of the fracture. This geometry is generated by a MATLAB® algorithm. Geologic properties arising from the fracture network is then upscaled using Oda's permeability tensor approach. The flow equation is solved using MATLAB® and COMSOL Multiphysics® software, a finite-element analysis software package, which numerically computes the solution of the 3D steady state and transient flow equations.

This work presents the reservoir domain response to the presence of activated fractures in the formation, subject to various pressure field and boundary property variations.