Single Phase Flow Models in Fractal Porous Media Using a Fractal Continuum Mechanics Approach

E. Linares-Pérez[1], M. Díaz-Viera[2]

[1]Instituto de Geofísica, Universidad Nacional Autónoma de México, Coyoacán, DF, México
[2]Instituto de Geofísica, Universidad Nacional Autónoma de México, Coyoacán, DF, México; Instituto Mexicano del Petróleo, Ciudad de México, DF, México

Abstract

The primary motivation of this work was to develop flow models in porous media with fractal properties to represent the anomalous behavior observed in some pressure tests in naturally fractured reservoirs.

Three mathematical models for single-phase flow in fractal porous media were derived applying a fractional continuum mechanics methodology. Two models were first derived for isotropic fractal media: one using the conventional Darcy's law and the other one a derived Darcy's law for isotropic fractal media. Whereas, a third model was derived based on a Darcy's law for anisotropic fractal media. The advantage of this approach is that the resulting fractional differential equations can be expressed as conventional differential equations but with coefficients as functions of fractal dimensions.

The numerical implementation of the three models was carried out using the PDE coefficient mode in COMSOL Multiphysics® software. Numerical results showed a consistent behavior with the expected anomalous behavior, where the pressure drops faster or slower in comparison with a conventional flow model.