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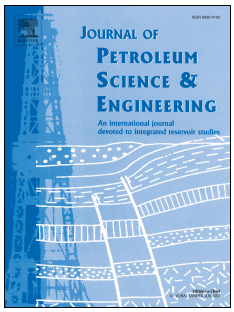


Research on stress-sensitivity of fractured porous media

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ACCEPTED MANUSCRIPT

# Research on Stress-Sensitivity of Fractured Porous Media

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## Abstract

Stress sensitivity parameters of a fracture are often tested under compression on both sides of the fractured medium, which is considered as an elastic solid. However, the elastic solid assumption will fail when two fracture surfaces, if applied to tensile stresses, are out of contact. In such cases, effective stress in the fracture is zero and the change of fracture aperture is not determined by the fracture itself, but by the deformation of the matrix and the overall deformation of the fractured region. This paper proposed a zero-stress model that is applicable after the failure of elastic fracture model as described above. The model analyzes the deformation mechanism of fractures and derives a new equation that can be used to describe the aperture and permeability behavior of a fractured medium under the condition of zero stress. The model is derived for different geometric shapes of fractured region under hydrostatic pressures. The model equations can be used to calculate aperture and permeability changes caused by the production of oil and gas from a reservoir as well as the injection of water or gases for EOR. Sensitivity analysis of the model found that both shape factor of the fractured region and elastic modulus of the surrounding rocks have a significant impact on the outcome of the aperture and permeability forecast as a function of changing pore pressure. The permeability model can also be used in reservoir engineering analysis and reservoir numerical simulation. The new model is joined with the traditional elastic model to better describe the deformation process of fractures.

Keywords: oil and gas reservoir, zero-stress model, high dip fracture, fracture aperture, fracture permeability

## 1. Introduction

Fractures are crucial to fractured reservoirs because they are the main channels or pathways for fluids to flow. Matrix blocks are often tight and poorly permeable in such reservoirs. Crudes stored in the pores of matrix firstly flow into the fracture and finally find their way to the wellbore.

Flow rate of fluids through fractures is directly affected by fracture permeability, which is a unique function of fracture aperture (Iwai 1976). Many laboratory tests have confirmed that the fracture permeability or fracture aperture is pressure sensitive (Rutqvist 2003, Guo et al. 2013, Huo et al. 2014). Bandis (1980) and Barton (1985) conducted a large body of experiments and proposed a constitutive model or the

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