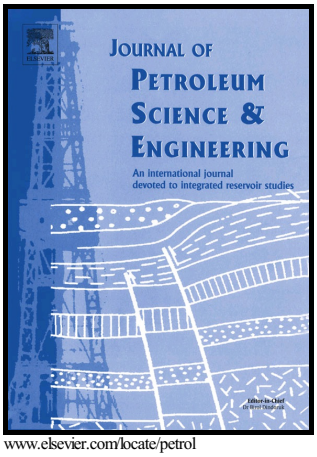

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Estimation of Permeability of Naturally Fractured Reservoirs by Pressure Transient Analysis: An Innovative Reservoir Characterisation and Flow Simulation

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Abstract

Fluid flow processes in naturally fractured reservoirs are strongly controlled by fracture intensity, their orientation, and interconnectivity. Therefore, knowledge of fracture properties plays a critical role in reservoir management. Developing a detailed description of subsurface fracture map is challenging for geothermal and petroleum industry due to a number of reasons: It is often difficult to obtain sufficient hard data such as borehole images and core description. Also, there is a general lack of quality of interpretation of soft data, such as well logs, seismic attributes, and tectonic history etc. for fracture interpretation. To overcome the short comings the industry has been relying heavily on geo-statistical analysis of both hard and soft data.

In this paper we used well test data (dynamic data) to reduce the level of uncertainty of the existing methods for generating fracture map through an innovative inversion technique. The major inversion techniques include simulated annealing, sequential successive linear estimator, and gradient and streamline based method. In this paper we used gradient based method which utilises adjoint equation. The inversion is carried out in a number of steps. First we analyse hard and soft data to generate characteristic fracture properties such as fracture density and fractal dimension. Next we use geo-statistical technique to spatially distribute fractures. Then with use of gradient based technique, we optimise the fracture attributes through different realisation. Next we use an innovative simulation of fluid flow through discrete fractures in 3D fractured porous media and estimated pressure and pressure derivatives. The pressure and pressure derivatives are compared with well test data taken from a typical fractured basement reservoir located in offshore Vietnam to determine percentage error.

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