The Effect of Stress Regime, Pre-existing Natural Fracture Geometric and Hydraulic Parameters and Stimulation Design Parameters on Fracture Stimulation and Fluid Flow Dimensions in the Otway Basin

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Abstract

The development of unconventional oil and gas resources is becoming increasingly important as conventional reserves start to decline. In order to make the recovery of unconventional resources from low permeability reservoirs economically viable, the process of hydraulic fracturing is critical. At present, only engineering measures are implemented in the design phase to enhance the stimulation process as there is very little understanding of how the geometry and properties of pre-existing natural fractures influences hydraulic fracturing.

This study analyses the effect of the in-situ stress regime and pre-existing natural fracture intensity, orientation, hydraulic parameters and stimulation treatment design parameters on fracture stimulation and fluid flow dimensions.

Wellbore image logs from 6 wells in the Otway Basin were used for the analysis of fracture orientation, intensity and size distribution. This was used to generate a model of the natural fracture network for simulation and evaluation of pressure transient testing and fracture stimulation.

Discrete fracture network modelling is an effective approach for evaluating hydraulic fracturing and fluid flow dimensions in naturally fractured reservoirs. It was found that hydraulic fractures do not necessarily propagate as a symmetrical bi-wing fracture exactly parallel to the direction of maximum principal stress. Propagation occurs in the direction of maximum principal stress, in a complex manner, involving initiation, connectivity and reactivation of the fractures. The microseismic-event density, percolation zone size and stimulated reservoir volume, as a result of fracture stimulation is directly correlated to pre-existing natural fracture intensity, fracture compressibility and stimulation pump rate, pump pressure and slurry density. Pressure derivatives show very different characteristics and therefore fluid flow dimensions with different fracture intensity and fracture orientation.

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