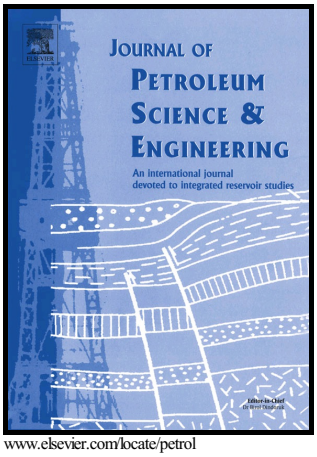

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Re-examining interpretations of non-ideal behavior during diagnostic fracture injection tests

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Abstract

Diagnostic fracture injection tests (DFITs) are performed in low permeability formations to estimate the minimum principal stress, formation pressure, permeability, and other parameters. G-function derivative plots are used for diagnosing fracture closure and "non-ideal" reservoir processes. In this study, we use a discrete fracture network hydraulic fracturing simulator to investigate non-ideal DFIT mechanisms. The simulator fully couples fluid flow with the stresses induced by fracture deformation. DFITs are simulated for six different scenarios: a single hydraulic fracture, multiple fracture strands, opening of transverse fractures, near-wellbore complexity, far-field complexity, and height recession. The results indicate that pressure transient behavior commonly ascribed to "fracture height recession," "closure of transverse fractures," and "fracture tip extension" are likely to be misinterpreted by conventional techniques. In previous studies, we found that a curving upward G×dP/dG plot is caused by changing fracture stiffness after closure and that the closure pressure is best picked when G×dP/dG begins to deviate upward. In contrast, the commonly used "tangent" method can significantly underestimate the minimum principal stress. The results of this study confirm those prior results. The results suggest that in most cases, it should be possible to use pump-in/flowback tests to confirm estimates of the minimum principal stress. However, if a flow bottleneck occurs at the wellbore due to near-wellbore complexity, the pump-in/flowback test may be uninterpretable.

Keywords: diagnostic fracture injection test (DFIT); hydraulic fracturing; mini frac DFIT; closure pressure; fracture stiffness; in-situ stress determination

1. Introduction

1.1 Background

Diagnostic fracture injection tests (DFITs) are used in low-permeability reservoirs to estimate the minimum principal stress, pore pressure, permeability, and other parameters. During a DFIT, a