

Author's Accepted Manuscript

Study of hydraulic fracturing processes in shale formations with complex geological settings

Bruno Figueiredo, Chin-Fu Tsang, Jonny Rutqvist, Auli Niemi



www.elsevier.com/locate/petrol

PII: S0920-4105(17)30370-4
DOI: <http://dx.doi.org/10.1016/j.petrol.2017.03.011>
Reference: PETROL3899

To appear in: *Journal of Petroleum Science and Engineering*

Received date: 11 July 2016
Revised date: 18 February 2017
Accepted date: 4 March 2017

Cite this article as: Bruno Figueiredo, Chin-Fu Tsang, Jonny Rutqvist and Auli Niemi, Study of hydraulic fracturing processes in shale formations with complex geological settings, *Journal of Petroleum Science and Engineering* <http://dx.doi.org/10.1016/j.petrol.2017.03.011>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain

Study of hydraulic fracturing processes in shale formations with complex geological settings

Bruno Figueiredo¹, Chin-Fu Tsang^{1,2}, Jonny Rutqvist² and Auli Niemi¹

¹Uppsala University, Villavägen 16, Uppsala, Sweden

²Lawrence Berkeley National Laboratory, Berkeley, California

bruno.figueiredo@geo.uu.se

Abstract

Hydraulic fracturing has been applied to extract gas from shale-gas reservoirs. Complicated geological settings, such as spatial variability of the rock mass properties, local heterogeneities, complex *in situ* stress field, and pre-existing bedding planes and faults, could make hydraulic fracturing a challenging task. In order to effectively and economically recover gas from such reservoirs, it is crucial to explore how hydraulic fracturing performs in such complex geological settings. For this purpose, numerical modelling plays an important role because such conditions cannot be reproduced by laboratory experiments. This paper focuses on the analysis of the influence of confining formations and pre-existing bedding planes and faults on the hydraulically-induced propagation of a vertical fracture, which will be called injection fracture, in a shale-gas reservoir. An elastic-brittle model based on material property degradation was implemented in a 2D finite-difference scheme and used for rock elements subjected to tension and shear failure. A base case is considered, in which the ratio SR between the magnitudes of the horizontal and vertical stresses, the permeability k_c of the confining formations, the elastic modulus E_p and initial permeability k_p of the bedding plane and the initial fault permeability k_f are fixed at reasonable values. In addition, the influence of multiple bedding planes, is investigated. Changes in pore pressure and permeability due to high pressure injection lasting 2 hours were analysed. Results show that in our case during the injection period the fracture reaches the confining formations and if the permeability of those layers is significantly larger than that of the shale, the pore pressure at the extended fracture tip decreases and fracture propagation becomes slower. After shut-in, the pore pressure decreases more and the fracture does not propagate any more. For bedding planes oriented perpendicular to the maximum principal stress direction and with the same elastic properties as the shale formation, results were found not to be influenced by their presence. In such a scenario, the impact of multiple bedding planes on fracture propagation is negligible. On the other hand, a bedding plane softer than the surrounding shale formation leads to a fracture propagation asymmetrical vertically with respect to the centre of the injection fracture with a more limited upward fracture propagation. A pre-existing fault leads to a decrease in fracture propagation because of fault reactivation with shear failure. This results in a smaller increase in injection fracture permeability and a slight higher injection pressure than that observed without the fault. Overall, results of a sensitivity analysis show

Download English Version:

<https://daneshyari.com/en/article/5484280>

Download Persian Version:

<https://daneshyari.com/article/5484280>

[Daneshyari.com](https://daneshyari.com)