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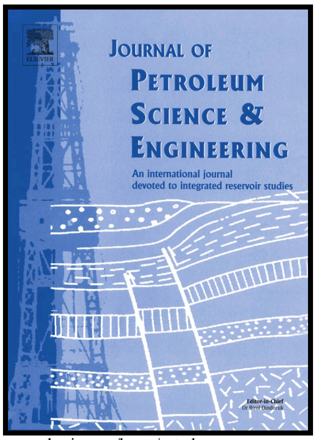

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PII: S0920-4105(17)30441-2
DOI: http://dx.doi.org/10.1016/j.petrol.2017.04.034
Reference: PETROL3974

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

Received date: 24 February 2017
Revised date: 10 April 2017
Accepted date: 25 April 2017

Cite this article as: Zhichao Li, Lianchong Li, Bo Huang, Liaoyuan Zhang, Min Li, Jiaqiang Zuo, Aishan Li and Qinglei Yu, Numerical Investigation on the Propagation Behavior of Hydraulic Fractures in Shale Reservoir based on th DIP Technique, *Journal of Petroleum Science and Engineering* http://dx.doi.org/10.1016/j.petrol.2017.04.034

Numerical Investigation on the Propagation Behavior of Hydraulic Fractures in Shale Reservoir based on the DIP Technique

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Abstract

Natural fractures play a key role in shale gas production. In this study, a digital-image-processing (DIP) technique is employed to characterize the digital images of shale samples with complex natural fractures. Incorporated the DIP technique with FEM code, the propagation behaviour of hydraulic fracture in fractured shale reservoirs is numerically investigated. Three digital images of in-situ shale samples are applied for numerical analysis. Numerical results reproduce the propagation of hydraulic fractures. The hydraulic fracturing process can be divided into three stages: (I)stress accumulation stage, (II)fracture steady propagation stage and (III) fracture unsteady propagation stage. The hydraulic fracture morphology is closely dependent on the natural fracture characteristics. More complex hydraulic fracture can be produced in reservoirs with denser natural fractures. Further numerical models are subsequently established to investigate the impact of the in-situ stress anisotropy and rock brittleness on the hydraulic fracture behaviour in shale. Reservoirs with lower in-situ stress anisotropy tend to produce more complex hydraulic fractures. Brittle minerals in the shale are more inclined to induce extensive fracture failure and require lower propagation pressure compared to the ductile mineral. The result can provide a reference to the research on the fracture propagation behaviour of the shale reservoir during fracturing stimulation.

Keywords: hydraulic fracture; numerical simulation; DIP technique; fracture propagation; stress anisotropy; brittleness