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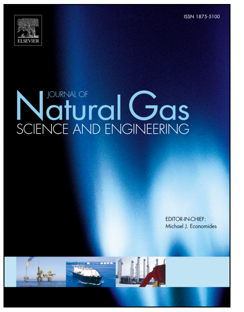

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XiaoLong Wang, Fang Shi, Chuang Liu, DeTang Lu, He Liu, HengAn Wu

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Extended finite element simulation of fracture network propagation in formation containing frictional and cemented natural fractures

XiaoLong Wang [a], Fang Shi [a, b], Chuang Liu [a], DeTang Lu [a], He Liu [c] and HengAn Wu [a*]

[a] CAS Key Laboratory of Mechanical Behavior and Design of Materials, Department of Modern Mechanics, University of Science and Technology of China, Hefei, Anhui 230027 China

[b] Faculty of Mechanical & Material Engineering, Huaiyin institute of technology, Huai'an, Jiangsu 223003 China

[c] PetroChina Research Institute of Petroleum Exploration & Development, 20 Xueyuan Road, Haidian District, Beijing 100083 China

*Corresponding author, wuha@ustc.edu.cn

Abstract

Shale gas reservoirs often need hydraulic fracturing treatments to create complex fracture network to enhance production. Frictional and cemented natural fractures are often contained in shale formations. The interactions between the hydraulic fractures and these two types of pre-existing natural fractures are different. In this study, we established a two-dimensional fluid-solid coupled hydraulic fracturing model using the extended finite element method (XFEM) to simulate the interactions between hydraulic fractures and natural fractures, and further the formation of fracture network. The results show that when a hydraulic fracture intersects with a natural fracture, the hydraulic fracture may be arrested and propagate along the direction of natural fracture, or cross the natural fracture without being affected. For the frictional natural fractures, the intersection angle, frictional coefficient, stress anisotropy and rock tensile strength have a significant influence on creating fracture network. It is found that decreasing stress difference and interfacial friction, or increasing rock tensile strength may lead to more complex fracture network. For the cemented natural fractures, the intersection angle and the ratio of cement toughness and rock toughness play critical roles in the creation of fracture network. Smaller intersection angle and cement toughness of NFs and larger rock fracture toughness often lead to more complex fracture network. In addition, for the same initial geometrical configuration of natural fractures, hydraulic fracturing often leads to more complex fracture network in formations containing frictional natural fractures