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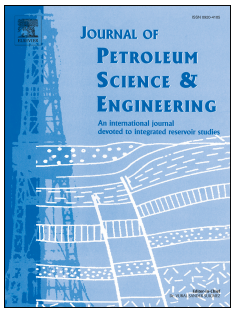

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Hydro-mechanical coupled mechanisms of hydraulic fracture propagation in rocks with cemented natural fractures

Zhiqiang Chen[a], Zhengming Yang[b] and Moran Wang[a,†]

[a]*Department of Engineering Mechanics and CNMM, Tsinghua University, Beijing 100084, China*
[b]*PetroChina Research Institute of Petroleum Exploration & Development, Langfang, Hebei 065007, China*

Abstract: Natural fractures commonly exist in unconventional reservoirs such as shale and tight gas sandstone, which are mostly cemented (or sealed) with minerals and not able to contribute to reservoir storage or rock permeability. However, during hydraulic fracture stimulation, these cemented natural fractures will be encountered and influence hydraulic fracture geometry greatly and, thereby, gas production. In this work, hydraulic fracture propagation in rock with cemented natural fracture is investigated using our recently developed and validated hydro-mechanical coupled LBM-DEM model. The numerical results show that both the strength ratio (between cemented natural fracture and host rock) and the approach angle (between hydraulic and cemented natural fracture) significantly affect the hydraulic fracture propagation. A larger strength contrast or a smaller approach angle will be more conducive to deflection, which is consistent with experimental observation. For rocks with weakly cemented natural fractures, deflection is mainly caused by shear failure in weakly cemented fracture. However, for rocks with strongly cemented natural fractures, deflection happens accompanying with tensile failure in host rock along the cement wall, which cannot be captured by the previous numerical models where the cemented natural fracture is treated as a bonded interface. In addition, complex fracture network is more easily formed if multiple weakly cemented natural fractures are orthogonal to the hydraulic fracture propagation direction.

Keywords: hydraulic fracture, cemented fracture, natural fracture, LBM-DEM

† Corresponding author: Email: mrwang@tsinghua.edu.cn; Tel: +86-10-627-87498