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Experimental investigation of the effect of natural fracture size on hydraulic fracture propagation in 3D

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1 **Experimental investigation of the effect of natural fracture size on hydraulic** 2 **fracture propagation in 3D**

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8 Key words: Hydraulic fracture; 3D intersection pattern; Natural fracture size; Shale; Bedding plane

9 **Abstract**

10 The three-dimensional hydraulic fracture (HF) geometry of intersection with the natural fracture (NF) is
11 significant in shale. In this paper, an orthogonal fracture intersection geometry pattern in 3D was
12 proposed, where the size of natural fracture was mainly studied. To verify the accuracy of the geometry
13 pattern, laboratory experiments were conducted separately in hydrostone and shale outcrop using the
14 true tri-axial system. The influence of NF size and bedding planes were investigated. The results show
15 that when HF intersection with different sizes of NF, the fracture propagation can be classified with five
16 ways: arresting, bypassing, diversion, vertical extension, vertical extension and then diversion. When
17 NF size is bigger than that of HF, it is more likely for HF to bypass, when smaller, more likely to diverse
18 or extend vertically. Well-developed bedding planes increase the probability of diversion to form
19 complex fracture network only when the size of NF is big. High fluctuation intensity of pump curve
20 indicates a more complex fracture network. When HF extends vertically, the curve shows an even
21 fluctuation, and when changes direction, the extension pressure will be much higher than fracturing
22 pressure. The 3D pattern and experimental results can predict fracture geometry and detect the fracture
23 network when intersection.

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