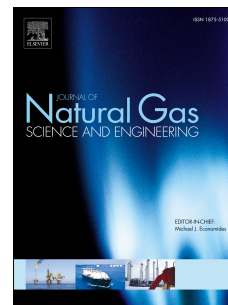


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Theoretical analysis of characteristics and influencing factors for channel fracturing conductivity

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1 Article

2 **Theoretical analysis of characteristics and influencing** 3 **factors for channel fracturing conductivity**

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7 **Abstract:** Channel fracturing is a novel hydraulic fracturing technology that is gaining
8 increased attention, and the conductivity optimization involved in this technology is
9 becoming a hotspot. However, for channel fracturing, recently presented conductivity
10 models are derived based on Darcy flow under idealized conditions. This limitation
11 motivates the development of the models that consider the new governing flow equations to
12 describe the real flow status in channel fracturing. In this work, a generalized conductivity
13 model is established by considering the embedment and pillar geometry of the proppant.
14 The interrelationships and interactions among embedment, permeability, conductivity
15 models are derived analytically. Based on evaluation with previously published
16 experimental data, theoretical analysis and comparison are performed. Results show that the
17 models can accurately describe the embedment, permeability, and conductivity change in
18 channel fracturing. The factors that influence changes in fracture conductivity are further
19 investigated by numerical simulations and we find that the theoretical conductivity model
20 can be used to characterize flow behavior under different conditions in channel fracturing.
21 This paper provides a theoretical basis for evaluating the critical factors governing
22 conductivity, thereby providing a reference for the optimization of construction in channel
23 fracturing design.

24 **Keywords:** embedment; power-law model; permeability; conductivity; channel fracturing

25

26 **1. Introduction**

27 As an essential stimulation technology in the petroleum industry, hydraulic fracturing
28 has been widely applied in extensive reservoirs by pumping into the wellbore with fracturing
29 fluid mixed with proppant to generate fractures in the target formations for oil or gas to flow
30 (Adams and Rowe, 2013; Golshani and Tran_Cong, 2008). Proppants are often
31 homogeneously distributed within fractures to resist the confining stress, support the fracture,
32 and reach desirable conductivity; thus, the production of hydrocarbon can be enhanced
33 remarkably (Cipolla et al., 2009; Warpinski, 2010; Warpinski et al., 2009). However, during the
34 production, the proppant gradually embeds into the rock formations under the confining
35 stress and fluid damage, which will result in a significant decrease in conductivity (Kunnath
36 et al., 2013; Zou et al., 2015; Weaver et al., 2010). Individuals have considered several
37 measures and techniques, such as improving proppant strength and deformation capacity,
38 developing new fracturing fluid system, or optimizing the combination of different types of
39 proppant, to stabilize fracture conductivity (Saldungaray et al., 2013; Kayumov et al., 2012).
40 Even so, the effectiveness of conductivity still cannot meet the expected requirements. Thus,
41 additional measures, such as refracturing, need to be considered to ensure production and
42 economic benefit (Pournik et al., 2010; Elbel et al., 1993; Araque et al., 2013). Under these
43 circumstances, the emergence of a novel fracturing technology is urgently needed to reduce
44 the cost of reservoir development and bring it back to economic level, especially under the
45 depression of the petroleum industry (Todd et al., 2015).

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