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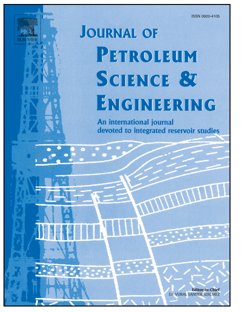

Numerical investigation of fluid injection into poorly consolidated geomaterial considering shear dilation and compaction

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Numerical investigation of fluid injection into poorly consolidated geomaterial considering shear dilation and compaction

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Abstract:

We present a fully coupled poroelastoplastic finite element model to simulate micro-fracture evolution, compaction failure and tensile fracture propagation during fluid injection into poorly consolidated geomaterial. The model includes shear dilation, strain hardening and fracture process zone with permeability evolution. We investigated the effects of geomechanics (stress anisotropy) and fluid injection (fluid rheology) on rock deformation and fracture behavior. Results indicate that fluid rheology dominate the rock failure. Pore pressure increase and water wedge effect can cause two kinds of shear dilation which are prior to tensile failure. The effect of compaction is significant to tensile fracture geometries, which differ from those under elastic and poroelastic conditions. The difference between shear band and compaction zone is the transition of fracture regime from the leak-off dominated to the storage dominated governed by fluid injection.

Keywords: fluid injection; poorly consolidated geomaterial; poroelastoplasticity; cohesive zone model; shear dilation; compaction failure.

1 Introduction

The failure mechanism of fluid injection into poorly consolidated geomaterial is a critical issue of basic and applied investigation in both geoscience and engineering fields. In deepwater reservoirs mainly composed of weakly consolidated offshore sediments, frac-pack treatments have been a growing practice for well stimulation, sand control and production (Abou-Sayed et al., 2004). Similar issues have also existed in other circumstances such as subsurface disposal of slurrified solid waste like reinjection of drilling cuttings (Crawford and Lescarboura, 1993; Guo et al., 2007), micro-fracturing by high-rate water pack (Sachdeva et al., 2001), micro-fracturing in

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