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Publication date
2019

Document Version
Final published version

Published in
Geophysical Research Abstracts (online)

Citation (APA)
Bakker, R., Hahn, S., Barnhoorn, A., Bruhn, D., Xiang, J., & Latham, J. P. (2019). Drilling laterals by high pressure water jets: does it work under in situ conditions and could it be an alternative for hydraulic fracturing? *Geophysical Research Abstracts (online)*, *21*, Article EGU2019-16357.

Geophysical Research Abstracts
Vol. 21, EGU2019-16357, 2019
EGU General Assembly 2019

Drilling laterals by high pressure water jets: does it work under in situ conditions and could it be an alternative for hydraulic fracturing?

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With increasing concerns of induced seismicity and in light of public acceptance, well operators and scientists are looking at alternatives to hydraulic fracturing with a lower seismic risk. One of such emerging technologies is the drilling of lateral boreholes from a central well using high pressure water jets. However, the success of this technology remains debatable, as some projects are successful while others fail, without a clear explanation why. Moreover, it is not clear if results from tests that were run at surface conditions translate to down-hole conditions.

We investigate the micromechanics of jet drilling ("jetting") under confined conditions by means of laboratory tests, microstructural analysis and numerical modelling. Laboratory tests consists of two types of tests:
1) Jetting rock samples under high pore pressure (up to 200 bar) using a high pressure vessel with a sealed feedthrough for a jetting assembly.
2) Jetting relatively large cubical samples (300 x 300 x 300 mm) under true-triaxial stress states, varying stress in individual directions from 5 up to 35 MPa.
We use a medical-grade CT scanner to analyse the geometry of the jetted borehole and analyse SEM images of cut sections to analyse potential damage around the jetted borehole. Parallel to this work, numerical efforts are undertaken to study the potential breakout behaviour of jetted laterals, using an in-house developed code: a combined finite-discrete element method with a cohesive zone fracture model (Solidity).

Combining our initial results, taking in account pore pressure effects as well as (local) stress states, we suggest a hypothesis that can explain the micromechanics of jetting. We argue that the success of jetting is strongly related to the local grain breakout, which is dependent on the local pore pressure in combination with the stress state. This implies that jetting can be successful under reservoir conditions, provided that the rock has some initial porosity.