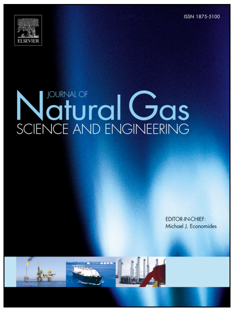
Accepted Manuscript



Analyzing wellbore stability in chemically-active anisotropic formations under thermal, hydraulic, mechanical and chemical loadings

Majed F. Kanfar, Z. Chen, S.S. Rahman

PII: S1875-5100(17)30051-3

DOI: 10.1016/j.jngse.2017.02.006

Reference: JNGSE 2059

To appear in: *Journal of Natural Gas Science and Engineering*

Received Date: 31 March 2016

Revised Date: 29 January 2017

Accepted Date: 1 February 2017

Please cite this article as: Kanfar, M.F., Chen, Z., Rahman, S.S., Analyzing wellbore stability in chemically-active anisotropic formations under thermal, hydraulic, mechanical and chemical loadings, *Journal of Natural Gas Science & Engineering* (2017), doi: 10.1016/j.jngse.2017.02.006.

Title: Analyzing Wellbore Stability in Chemically-Active Anisotropic Formations under Thermal, Hydraulic, Mechanical and Chemical Loadings

Authors Order: Majed F. Kanfar *, Z. Chen, S.S. Rahman,
School of Petroleum Engineering, University of New South Wales, Australia
*Corresponding author: Email address: m.kanfar@student.unsw.edu.au (Majed Kanfar)

Keywords: anisotropy; porochemothermoelasticity; THMC; thermo-chemo-hydro-mechanical; wellbore stability; shale

Abstract

Several factors influence the stress state in subsurface rocks. In addition to pore pressure and far-field in-situ stresses, thermal and chemical gradients have substantial bearings on the in-situ stress state during and after drilling operations. Drilling inclined boreholes through laminated formations such as shaley sands presents several challenges. Due to their laminated nature, shales demonstrate high degree of elastic anisotropy, and are often chemically-reactive to drilling fluid. The majority of models utilized in the industry assume a homogeneous isotropic elastic static model that fails to give an accurate depiction of the observed borehole failure. In this work, governing equations for anisotropic porochemothermoelasticity are developed to simulate the drilling of an inclined borehole problem in a transversely isotropic rock. Using the developed constitutive and transport equations, a finite element method based numerical model is constructed to estimate the pore pressure, temperature, solute concentration and stress distribution. Nonlinear conductive-convective heat transfer and diffusive-advective solute transfer models are considered in this work to address both high and low permeability formations. Finally, the model is used to assess time-dependent wellbore stability during and after drilling. The novel pseudo-3D analysis developed in this work is advantageous for real-time operations due to its computational speed and stability.